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SESSION 1853—54.

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SOME REMARKS UPON THE BUILDINGS OF LILLE IN FRANCE, AND A DESCRIPTION OF A FINE COLLECTION OF ORIGINAL DRAWINGS BY THE GREAT ITALIAN MASTERS, BEQUEATHED TO LILLE, HIS NATIVE TOWN, BY THE LATE MONS. WICAR, DIRECTOR OF THE ACADEMY OF NAPLES; PARTICULARLY IN REFERENCE TO A SERIES OF ARCHITECTURAL SKETCHES ATTRIBUTED TO MICHAEL ANGELO. WITH ILLUSTRATIONS.

By T. L. Donaldson, Honorary Secretary for Foreign Correspondence.

Read at the Ordinary General Meeting of the Royal Institute of British Architects, November 14th, 1853.

The City of Lille has hitherto been more remarkable for the extent and strength of its fortifications, which were deemed a masterpiece of the great Vauban, than for its architectural monuments; for although its Hotel de Ville still retains some points of architectural and antiquarian interest, and some of the churches evince considerable elegance and skill in design, yet they do not boast any very remote antiquity, are not distinguished for their decoration, and its tallest spires and towers have been destroyed during sieges at various periods; the most disastrous of which was the nine days' bombardment by the Austrians in 1792, under the Prince of Saxe Teschen, which brought down some of its loftiest and proudest monuments.

There are two "*Places*," nearly together; one of considerable size, the other much smaller. Some of the streets are of tolerable width, and run in straight lines to the city gates. Many of the houses are attributed to the times when the Spaniards ruled the country, in the 16th and 17th centuries, and exhibit signs of affluence and ease; the fronts being much decorated with pilasters, enriched capitals, capriciously decorated doors and windows of the Italian taste and of heavy proportions.

There are six parish churches, three of which are Gothic. S. Maurice, the Cathedral, is remarkable for its five aisles of equal height, divided by cylindrical pillars. The end is apsidal, the sides being formed into polygonal chapels, like those at Westminster Abbey. The effect of the various vistas of the interior is very striking, and the combination of the several parts produces most pleasing and effective groupings. The Church of S. Sauveur had once a noble stone spire with pierced tracery, but the cannon balls of the Austrians brought it to the ground in 1792. The Church of S. Catherine, a Gothic structure, seemed to me peculiarly adapted for one of our churches, as it consists of a nave and side aisles divided by cylindrical pillars, which being twelve diameters apart, offer little obstruction to the sight. The Church of the Magdalen, of Italian design, has a central circular hall as it were, with a circular aisle around it, from which radiate the choir in an easterly direction, and corresponding chapels to the north and south, with considerable effect. The two other churches are those of S. André, and the Jesuits', on the usual Italian model, divided by columns and piers; spacious, airy and simple, and on a noble scale. In the last of these considerable appearance of extent is given by the end of the side aisles being painted to represent a distant vista: by this expedient great lightness of effect is given, and the deadness of a blank wall avoided, although it must be considered to be somewhat a meretricious expedient. There are several modern buildings of considerable importance, among which is a Lycée, of great extent of plan, now in course of erection, and the Hotel de Ville, formerly the Palais de Rihour. So much of the old part of this edifice as now remains, is of the Gothic style; it was originally enlarged and completed in 1430, by Philippe le Bon, Duke of Burgundy and Count of Flanders, whose device of the flint and steel is gracefully introduced on the staircase, in the ornaments of the groined vaulting of the interpenetration character, the mouldings of which are very curiously interlaced. Besides this staircase there are few remains of the ancient fabric, which is now being superseded by the spacious and noble structure, rising from the designs of Mons. Benvignat. But there is still an old lofty hall with a groined ceiling, called

the Salle du Conclave, which also contains some fine paintings, well combining with its architecture and fittings. Mons. Benvignat and the authorities have every disposition to retain these striking features of the old Palais, associated as they are with many historical circumstances, such as the holding the second chapter of the Golden Fleece in 1431; the meeting of Charles V. and our Henry VIII. in 1541, and with brief residences of Louis XIV. in 1670, and of Louis XV. in 1744.

The old Palais de Rihour was so generally dilapidated, that a few years ago it was determined to take it down, and erect on the site a new Hotel de Ville; and the work was confided to Mons. Benvignat, who has designed it on an ample scale, with lofty storeys, grand vestibules and halls, spacious staircases, and well lighted picture galleries. The columns are of the blue lias formation procured from Belgium near Tournay, the shafts being monoliths, and the pedestals and bases also in single blocks of considerable dimensions.

The Museum, the City Library, and Municipal Offices are contained within this fine building. You will remember that on a former occasion, when I described to you the public institutions of Caen and Arras, I alluded to the noble munificence and public spirit with which the principal cities of France were endowed with institutions on a grand scale, and of an useful and intellectual character: and it must be acknowledged that, however detrimental the octroi may be considered to the commerce of a place, its revenues have procured to the leading cities of France, institutions and edifices which we may well envy them; and we can hardly hope that the merely permissive character of recent enactments in this country can ever realise such results as have been effected in France. A majestic staircase, adorned in part with casts from our Elgin marbles, leads to the Public Museum of Lille, which consists of seven rooms of noble dimensions, four of them containing some very creditable productions of ancient and modern painters, and copies of some pictures by Paul Veronese, Raphael, Rubens, Vandyke, and other leading masters.

But the most precious portion of these works of art is a collection containing about 1200 original drawings; 197 attributed to Michael Angelo, 3 to Leonardo da Vinci, 68 to Raphael, 13 to Masaccio, 6 to Andrea del Sarto, 9 to Bandinelli, 1 to Paolo Veronese, 1 to Perugino, 1 to Gian. Bellino, 8 to Annibale Caracci, 2 to Coreggio, 17 to Carlo Dolci, 10 to Fra Bartolomeo, 15 to Francia, 8 to Guercino, 5 to Ghirlandajo, 3 to Giulio Romano, 1 to Palma, 5 to Parmegiano, 6 to Poussin, 2 to Tintoretto, 8 to Titian, 2 to Albert Dürer, 3 to Lucas de Leyde, 1 to Rembrandt, and 1 to David.

Many of these are apparently first sketches of pictures, which have since acquired the highest reputation, and shew the gradual steps by which the great masters progressively improved the rude embryos of their first thoughts; and in order to compare the original ideas with the finished works, there are engravings of the pictures as completed. Some are in pencil, others in black or red chalk, and several in bistre. A most lovely model in wax, attributed to Raphael, of a female head the size of life colored to nature, the contour, pose and expression of which recal the perfection of Greek art, rivets the attention of every visitor. It is fractured in the neck, and evidently is of so frail a nature that, however anxious has been the desire to take a cast, the success seems too hazardous to justify the attempt. The drapery covering the bust, and the pedestal are of terra-cotta of a later period. I consider this the gem of the collection.

To architects the most precious portion of the drawings, is a series of 185 sketches of architectural subjects attributed to the pencil of Michael Angelo. They are now mounted in glazed frames, so arranged as to shew both sides of the sheets, as they originally were in a sketch book, and with drawings on both sides, the size 8 inches by 5. They are generally drawn in bistre, and the plans tinted with a light shade of that color. To some there are dimensions; others have the words *a dischretione e nō e misurato:* sometimes the word *anticho* is added. They consist of plans, sections, details, and some few elevations, of various ancient and modern buildings. Among the former are the arches of Titus, Septimius Severus, Janus, and Constantine, at Rome; of Augustus at Pola, in Istria; a plan and details of the Coliseum. Some seem to be plans of Ædicula or tombs, like those then abounding in the Campagna; and I find No. 439 to be identical with the plan of plate 24 of Montano's Scelta di varii Tempietti Antichi. There is a sketch in

pencil of the drum, under the cupola of S. Peter's at Rome, as designed and executed by Michael Angelo, with the abutment piers and coupled engaged columns, instead of the continuous colonnade of previous designs, whether by Bramante or S. Gallo; and above are some loose lines in pencil indicating the dome, though not very definitely, and more like the Pantheon than S. Peter's. There are several drawings of the parts of the Church of S. Pietro in Montorio, which was designed and built by Bramante, the cotemporary of Michael Angelo and uncle of Raphael; and many sketches of the Baptistery at Florence, of the Lantern of S. Lorenzo, a plan of the Chiesa degli Angeli by Brunelleschi, and other buildings in that city, and particularly of the Medicean Library, designed and almost entirely executed by Michael Angelo, but completed by Vasari, to which I shall again more particularly allude. There are sketches of vases, arabesques, pulpits, and groups of trophies of ancient Roman armour.

During the short period of time that I was enabled to devote to the careful examination of these drawings, I sketched off some of the plans, which I have had since drawn out to about twice the size of the originals, in order to give an idea of the interesting character of the series. One of these, enlarged more than the others on account of its importance, gives a restoration of the Ruin in the Campo Vaccino, known as the Temple of Peace, or as our friend Mr. Burgess, and other antiquaries, call it, the Basilica of Constantine. It gave rise to some discussion, when Mr. Burgess favored us during the last Session with his instructive paper on the ancient Basilica and early Christian Temple. The sketch contains these original remarkable words upon it in Italian: "(questa una pianta d'una chiesa moderna no so di chi sia mano)"; "this is a plan of a modern church by I know not what hand." Now the restoration of this ruin, as you are aware, has puzzled antiquarians and architects from the time of Serlio to that of Palladio, and down to the present period. Its name, its destination and its plan have been a constant enigma: but it appears stranger still, if Michael Angelo be the author of these sketches, that he should copy the idea of another, call it a modern church, and say he knew not by what hand, when from his constant residence at Rome, he must have had a thorough knowledge of the pile, whose three arches rise with such majestic grandeur among the ruins of the Campo Vaccino, and his eye, familiar with the building, must have recognized at once an adaptation and not a "*chiesa moderna*." A curious coincidence is, that he himself, whether before the date of this sketch or after it is impossible to say, converted a similar hall in the Baths of Diocletian to the purposes of religious worship. The church, a majestic one from its size and simplicity, is known as the Madonna degli Angeli, and is interesting also to artists as containing the tombs of Carlo Maratti and Salvator Rosa; the grand hall is 198 ft. long by 84 ft. wide, independently of the end chapels, which give an additional length of 65 ft. each, making a total length of 328 ft. These measurements were taken by Mr. Hardwick and myself, when we were together in Rome in 1818.

This sketch suggests many remarkable considerations. It omits the large lateral niche; it fills in small columns between the large arches of the nave, and thus decidedly separates the central nave from the side aisles; it adds small columns to the niches, as though each had a tabernacle, as in the Pantheon, a very probable conclusion. But the most important circumstance is the addition, at one end, of a noble portico of large proportions; where from the time of Serlio to the present period, comprehending Palladio and Canina, the space is supposed to be occupied by a paltry arcade. As such a feature is irreconcileable with the broad treatment of the rest of the edifice, and considering the arcade to be a construction of more recent times, it seems more consistent with the true spirit of the original design to give it a more dignified façade, than that of Palladio or Canina, so as to be accordant with its size and disposition, maintaining its importance with the Temple of Venus and Rome immediately adjacent, and the other magnificent buildings of the Roman Forum, to which it is contiguous.

Our friend, Mons. Hittorff, to whom I sent a copy of this sketch, has called my attention to the similarity between the plan of this portico, and that of a portico to S. Peter's attributed to Michael Angelo; they are placed side by side on one of the illustrations now exhibited, the only difference consisting in the

number of the columns,—the one being for a tetrastyle, the other for a hexastyle portico, and the projection of the porticos being respectively two and three intercolumniations. But our distinguished Honorary and Corresponding Fellow, calls attention to another suggestion presented by the plan, which forcibly revives an early impression upon his mind, that the primitive plan of S. Peter's at Rome, as designed by Bramante, consisting of a simple Greek cross, and divested of its superfluous accessories, would seem to have been suggested by the plan of this ruin, with which in its main lines and features it palpably corresponds.

Such are some of the speculations, which arise from the contemplation of this plan and the startling words—"*chiesa moderna no so di chi sia mano.*"

I shall not perplex you nor myself by any lengthened speculations upon the real character and destination of this edifice. Its plan is wholly at variance with the type presented in any known temple of the Greeks or Romans: hence the name of Temple of Peace seems inappropriate. Its plan is no less discordant from the precepts of Vitruvius, or any other basilica in ancient Rome, hence the term Basilica of Constantine would remove it from the usual basilican canon; and experience does not teach us that the Romans of later times departed very materially or radically from established previous types. But its vicinity to the Domus Aurea of Nero makes me inclined to consider it as a vestibule to that noble palace, partially saved from the conflagration, restored, added to by Maxentius, and possibly christened with a new name in periods much subsequent to its original erection.—And now *Requiescat in Pace.*

The next sketch, to which I invite attention, is that of the plan of the Vestibule to the Medicean Library at Florence. Those, who have visited that building, will remember the vestibule and its strangely planned flight of steps, leading up into the library: and they will recal the columns sunk in the walls, and other grotesque mixtures of heterogenous forms in the details, which fully bear out what Vasari says of Michael Angelo,* and who thinks to praise the master for having "composed a decoration of" what he calls, "a richer and more varied character than had ever before been adopted, either by ancient or modern masters. The beautiful cornices," says he, "the capitals, the bases, the doors, the niches, were all very different from those in common use, and from what was considered *measure, rule and order by Vitruvius* and the ancients; to whose rules *he would not restrict himself.* But this boldness on his part has encouraged other artists to an injudicious imitation, and new fancies are continually seen, many of which belong to '*grottesche,*' rather than to the wholesome rules of ornamentation. Artists," continues Vasari, "are nevertheless under great obligations to Michaelagnolo, seeing that he has thus broken the barriers and chains, whereby they were perpetually compelled to walk in a beaten path, while he still more effectually completed this liberation, and made known his own views in the Library of San Lorenzo, erected at the same place. The admirable distribution of the windows, the construction of the ceiling, and the fine entrance of the vestibule, can never sufficiently be extolled. Boldness and grace are in the work as a whole, and in every part: in the cornices, the corbels, the niches for statues, the commodious staircase and its fanciful divisions —in all the building, at a word, which is so unlike the common fashion of treatment, that every one stands amazed at the sight thereof."

The Medicean Family having collected a vast quantity of very fine manuscripts of the classic authors from the Greeks, who had been driven from Constantinople, and from other sources, were anxious to provide a receptacle worthy so rich a treasure.† Clement VII, one of the Medicean Popes, was desirous of establishing memorials to his fame in sculpture, painting and architecture, as Leo and his other predecessors had done. This was about 1625, and Michael Angelo was summoned to Florence to design the library, to be called that of San Lorenzo, with a new sacristy to the church, wherein the Pope proposed to erect the

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* Vasari's Lives, translated by Mrs. Foster, vol. v. p. 272.

† Page 271.

marble tombs of his forefathers,* two to enclose the remains of the fathers of the two Popes, Lorenzo the elder and Giuliano his brother, with those of Giuliano Duke of Nemours, the brother of Leo, and of Lorenzo Duke of Urbino his nephew.

Eight years afterwards, in 1533, Pope Clement died,† when the works then proceeding at the library and sacristy in Florence, which, notwithstanding all the efforts made, were not yet finished, were at once laid aside. Towards the middle of 1555, during the time of Paul III, "Duke Cosinio had sent Tribolo to Rome, to try if he could persuade Michaelagnolo to return to Florence, there to finish the sacristy of San Lorenzo; but the master had excused himself, saying, that he was become old, might no longer endure the fatigue of labor, and could not leave Rome. Tribolo then enquired as to the steps for the library of San Lorenzo, for which Michaelagnolo had caused many of the stones to be prepared, but for which no model nor any certain indication of the form in which they were to be constructed, could be found. It is true, that there were some few sketches of a pavement and other things in terra, yet the correct and final design of the work could not be ascertained. But not all the entreaties of Tribolo, although he brought in the name of the Duke, could move Michelagnolo to say more than that he did not remember. The Duke then commanded Vasari to write to the master, since it was hoped that for the love of him, Michelagnolo would perhaps say something, which might enable them to bring the work to conclusion. Vasari wrote to him accordingly as the Duke desired, adding, that of all which had to be done Vasari was to be the director, and would do everything with the utmost fidelity, taking care of every minutia, as of a work of his own. To this Michelagnolo replied by sending the plans for the work in a letter, written by his own hand, on the 28th Sep^{r}. 1555. 'Messer Giorgio, my dear friend—About the staircase, whereof there has been so much said, believe me, that if I could remember how I had arranged it, I should not require so many entreaties. There is a certain stair, that comes into my thoughts like a dream; but I do not think it is exactly the one which I had planned at that time, seeing that it appears to be but a clumsy affair; I will describe it for you nevertheless. I took a number of oval boxes, each about one palm deep, but not of equal length and breadth. The first and largest I placed on the pavement at such distance from the wall of the door, as seemed to be required by the greater or lesser degree of steepness you may wish to give to the stair. Over this was placed another, smaller in all directions, and leaving sufficient room on that beneath for the foot to rest on in ascending; thus diminishing each step as it gradually retires towards the door; the uppermost step being exactly of the width required for the door itself. This part of the oval steps must have two wings, one right, the other left. The steps of the wings to rise by similar degrees, but not to be oval in form. The ascent by the middle flight, from the centre to the upper part, shall be for the Signore; the turn of the wings must be towards the wall. But from the centre downwards to the pavement, they shall be kept at the distance of about three palms, in such sort that the basement of the vestibule shall not be infringed upon in any part. What I am writing is a thing to be laughed at, but I know well that you will find something suitable to your purpose.'"‡

In a brief conversation on the subject, which I had with Monsieur Benvignat, the architect of Lille, he gave it as his opinion, that the sketch exhibited in the Wicar collection is the original idea of Michael Angelo; that he had lost the book, and forgotten this his first conception. But the sketch is equally at variance with the master's letter just quoted, and the staircase as executed. The sketch presents an oval series of steps,

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* Vasari's Lives, translated by Mrs. Foster, vol. v. p. 272. † Page 282.

‡ Gaye in his Carteggio, makes it doubtful whether Vasari finished these steps or not; and a Florentine commentator says, "Although Michael Angelo had left the steps, the balustrade, and many other parts of this work in a state of preparation, it is manifest that Vasari did not succeed in comprehending the master's wish. He constructed a magnificent flight of steps, without doubt, but not that intended by Michael Angelo."—See *Ruggieri, Studio d'Architettura Civile*; also *Rossi, Libreria Medicea Laurenziana.*

half without and half within the door of the library; but the number would not have accomplished half the height to which it was necessary to rise, and although oval like the boxes alluded to by Michael Angelo, there are no side steps.

So restricted is the vestibule, that the intrusion upon the space of the floor, by the capricious form given to the flight as executed, leaves very inadequate room for the landing at the bottom of the stairs; and if any method could have been devised of gaining space by making some of the steps rise within the doorway, much convenience would have been gained. I am inclined therefore to think that this sketch is a slight idea of Vasari's, founded upon some vague rumour of Michael Angelo's arrangement, to try how it could be carried into execution, before he had received the master's formal instructions.

This brings us to the consideration of the important question, who was the real author of these sketches? My own impression is, that *the whole book* may be attributed to Vasari himself—that all the sketches of the Library, of the Cupolino of the Sepulchral Chapel, and of the other details of Michael Angelo's work, were taken for his own guidance, or for the purpose of sending off copies to the Master, to enable him to give the proper instructions to direct Vasari's proceedings in the completion of the buildings confided to his care.

The sketches generally are executed with a certain ready freedom of hand and no great care; but some are drawn with much delicacy and with considerable precision and minuteness of form. Hardly more than two or three evince that bold and vigorons freedom of treatment, which we are accustomed to consider as characteristic of the Maestro, as Vasari repeatedly calls him. One circumstance particularly struck me, and that was the numerous sketches of the circular chapel built in the cloister court of S. Pietro a Montorio, by Bramante. This building excited vast admiration at the time, and Serlio himself gives the plans, elevations and sections of it in his work next to those of the cupola of S. Peter's, and among the numerous illustrations of ancient buildings, and Palladio also gives it among his ancient edifices. Other writers of the time mention it with unqualified praise. It would therefore be no wonder if a Vasari, who was employed upon designs and models for tombs at S. Pietro a Montorio by order of Julius III., should have sketched parts and kept a record of such details. But that Michael Angelo, who despised the trammels of *ancient art*, should condescend to the task of minutely drawing the work of a cotemporary, and that cotemporary no friend of his, but the uncle and supporter of his rival Raphael, and one, who crossed him in his great work for the tomb of Julius, seems beyond probability, however noble were many impulses of Michael Angelo's generous nature. I am given to understand, that many French artists, who have visited the Wicar collection, concur in my opinion as to the propriety of not attributing this collection of sketches to Michael Angelo; and a distinguished member of the French Institute, a great amateur and connoisseur, assures my friend Hittorff, that he had traced the writing on some of these drawings, and that it did not at all accord with that of the great master. I am therefore confirmed in the conviction, that these architectural sketches are not the production of Michael Angelo.

I shall now notice a letter from Francois I. to MichaelAngelo; but before I put you in possession of this most precious of the treasures of the Wicart collection, it is necessary for me to give a few particulars of one, to whom it refers, and which I shall do by quoting another passage or two from Vasari. Francesco Primaticcio was sent by the Duke Frederigo of Mantua to France, at the request of Francis I., who, having heard of the decorations, with which he was adorning the Palazzo del T, desired to have an able artist to execute like works for him at Fontainebleau, and elsewhere. Primaticcio, according to Vasari, was the first to paint frescoes of any account for the French king, and we all know how admirably he succeeded in the great and superb ball room at Fontainebleau.

"King Francis, being much pleased with the conduct and proceedings of Primaticcio, sent him in 1540 to Rome, he having put the wish, according to Benvenuto Cellini,† into that monarch's head to possess antiques. He purchased several antiques in marble, and served the king so diligently, that what with

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* Vasari's Lives, translated by Mrs. Foster, vol. v. p. 371.

† Vita, vol. ii. p. 131, Ediz. di Milano, 1811, 8vo.

heads, trunks, and entire figures, he bought in no long time 125 pieces. At the same time Primaticcio caused Barozzi da Vignola and others to copy the bronze horse of the Capitol, the greater part of the relievi of the column, (probably Trajan's,) the statue of Commodus, the Venus, Laocoon, the Tiber, the Nile, and the statue of Cleopatra, which are in the Belvedere, and all which were to be cast in bronze."

" Being recalled to Paris he returned immediately. But, before attending to any other occupation, Primaticcio caused the greater part of those antiques to be cast, when all succeeded so well, that they might be taken for veritable works of antiquity, as may still be seen" says Vasari " in the Queen's garden at Fontainebleau, where they were placed to the great satisfaction of King Francis, who may be said to have there made another Rome."

" The king, perceiving that he had been well served during the eight years, that Primaticcio had been with him, appointed the painter to be one of his Chamberlains. And shortly after (in 1544 that is to say) his Majesty made him Abbot of S. Martin (at Troyes.) "

The document, which rendered necessary these preliminary remarks, is as follows:

S^{r} Michelangelo pourceque jay grant desir davoir quelques besognes de v̄re ouvrage jay donne charge a labbe de Sainct Martin de Troyes pñt porteur que jenvoye pardela den recouvrir vous priant si vous avez quelques choses excellentes faictes a son arrivee les luy voulloir bailler en les vous bien payant ainsique je luy ay donne charge Et davantaige voulloir estre contant pour lamour de moy quil molle le christ de la Minerve † et la n̄re dame de la febre ‡ affinque jen puisse aorner lune de mes chappelles comme de chose que lon ma asseure estre des plus exquises et excellentes en v̄re art. Priant dieu S^{r} Michelango (sic) quil vous ayt en sagarde. Escript a Sainct germain en Laye le VIII^{e} jour de feurier mv^{c}xlv.

FRANCOYS.

No. 199. DELAUBESPINE.

This letter proves that Primaticcio must have made a second visit to Italy for the purpose of collecting more works of art, and its truly princely sentiments evince the taste, the liberality, and high-minded generosity of a real lover of the fine arts. How fortunate has France been for three centuries in having princes who felt, that the fine arts can contribute essentially to the refinement, the happiness, and prosperity of a nation. This spirit has endowed Fontainebleau, Paris, and Versailles with the masterly productions of the greatest minds in Italy and France. The lower orders have their enjoyments in common with the princes, the nobles, and gentry of the land; and they grow up imbued with the love of that art, which is so mixed up with their holiday enjoyments, that it becomes a necessity, as it were, from their being used to it from their earliest years; and they are thus unconsciously educated by the contemplation of the finest works. How far are we in this respect behind our neighbours. The gardens of the Tuilleries have no parallel with our royal residence of Buckingham Palace; and Fontainebleau puts to shame the courts, and terraces, and gardens, and walks of Windsor Castle, which contain hardly a single statue, group, or fountain, or other art accessories of any consequence, and appear cold and meagre, and poverty stricken from the want of such accompaniments. So niggardly and deficient in art feeling have those authorities been, who have hitherto had to provide for the palaces of our Sovereigns, and the places of public resort for the people. Often was Francois I. thwarted by his ministers in his munificent desire to promote the fine arts, but he was not to be turned away from an object, which he knew would gratify his people and ennoble his country. And well has this noble spirit been rewarded for his early enlightened cultivation of the fine arts, for his example

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* This celebrated statue is still preserved in the Church of the Minerva, near the Pantheon, Rome.

† This statue was, according to Vasari, executed for the Cardinale di S. Dionigi, to put in old S. Peter's, in the Chapel of the Virgin Mary of the Fever. I have made ineffectual enquiries to ascertain precisely where this statue is. Mons. Hittorff thinks it the Madonna della Pietà, the cast of which was in one of the chapels of Fontainebleau up to the time of the Revolution. Probably it may be the Pietà of S. Peter's, at Rome, re-named after the time of Vasari.

has been followed by the continued munificence of succeeding monarchs and ministers, which has produced that superiority in the art productions of their manufactures, which enables them to compete so successfully with the mere mechanical skill and industry of other nations.

Michael Angelo has been the main topic, to which I have been so bold as to claim your attention; and surely his position as an artist claims for him the respect and admiration of every painter, sculptor and architect. And although he was a great innovator in architecture, and introduced a license, which was most pernicious to the art, yet we cannot but recollect that we owe to him the simplicity of design, to which he reduced the cupola and other decorations of S. Peter's, which had been sadly corrupted by the immediate successors of Bramante, whose original conception had been lost. Vasari mentions* that "while Antonio San Gallo lived, Pope Paul had permitted him to continue the building of the Farnese Palace. But the upper cornice on the outside was still wanting; and his Holiness now desired, that this should be added by Michael Angelo, after his own design and under his direction. The master, therefore, not willing to disoblige the Pope, who esteemed and favored him so much, made a model in wood, seven braccia long ($13\frac{1}{2}$ ft.), and of the exact size which the cornice was to be. This he caused to be fixed on one of the angles of the palace, that the effect might be seen, when, as the Pontiff and all Rome with him were much pleased therewith, it was put in execution, proving to be the most beautiful and varied cornice ever erected, either by the ancients or moderns.† He continued the great court also, constructing two ranges of columns over those first erected, with the most beautiful windows, and a great variety of rich ornaments, ending with the great cornice; all of these works being so beautiful, that this Court by the labor of Michael Angelo has now become the finest of all Europe."

You will doubtless remember the beautiful picture by Haghe in the New Water Color Exhibition of the year 1848,‡ representing Michael Angelo, himself an old man, nursing by his midnight lamp his faithful servant Urbino, who was ill; his master sleeping at night in his clothes beside him, the better to watch for his comforts. Vasari gives the following touching letter written to him by Michael Angelo on this occasion: "My dear Messer Giorgio—I can but ill write at this time, yet to reply to your letter I will try to say something. You know that Urbino is dead, and herein have I received a great mercy from God, but to my heavy grief and infinite loss. The mercy is this, that whereas in his life he has kept me living, so in his death he hath taught me to die, not only without regret, but with the desire to depart. I have had him twenty-six years, have ever found him singularly faithful, and now, that I have made him rich, and hoped to have in him the staff and support of my old age, he has disappeared from my sight, nor have I now left any other hope, than that of rejoining him in paradise. But of this God has given me a foretaste, in the most blessed death that he has died: his own departure did not grieve him (so much) as did the leaving me in this treacherous world with so many troubles. Truly is the best part of my being now gone with him, nor is anything now left me, except an infinite sorrow. And herewith I bid you farewell."

I have been insensibly led, by the interest, which attaches to the talents and character of this great man, to depart from the immediate subject of my paper, and to conclude my remarks by an allusion to his works at the Farnese, and by the contemplation for a moment of the affecting incident, which lays open the inmost soul of Michael Angelo, and shews him with the tenderest regard as a kind master, and the finest feelings of the most pious resignation in the contemplation of his own not far distant end,—as exemplary as a Christian, as he had been eminent and admirable as an artist. But I will now conclude, and trust,

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* Vasari's Lives, translated by Mrs. Foster, vol. v. pp. 296-7.

† The cornice to the Strozzi Palace at Florence, must have suggested to Michael Angelo the grandiose character of that of the Farnese of Rome.

‡ See Illustrated London News, 22nd July 1848.

that I may not be considered too presumptuous in so boldly offering my opinion as to the authorship of these architectural sketches. Whosesoever they may be, whether Michael Angelo's, or Vasari's, or any other artist's, they are extremely curious and interesting in the history of our art. I hope that none of my professional brethren, who have not yet seen these drawings, will now pass through Lille without visiting this fine collection. They will then, in addition to the delight they will experience in seeing the masterly thought-renderings of other great men, be enabled to judge for themselves and to decide; whether I am wrong or right in hesitating to attribute to the mighty Florentine these architectural sketches, which well deserve the minutest attention from every lover of architecture.

The President, Earl de Grey, called upon the Meeting to award their thanks to Mr. Donaldson, for his interesting and valuable paper, which he was confident they would do unanimously.

Mr. Tite, Fellow, stated it had happened to him, in the summer of last year, to be detained in Lille for five hours on a wet afternoon, waiting for the train to Calais, when he was directed to the Musée, in order to pass a portion of that time. Proceeding to the rather magnificent Hotel de Ville described by Mr. Donaldson, of which he had never heard before, he was astonished to find, not only the marvellous collection of drawings referred to, but an extensive and interesting museum, illustrative of art, antiquity and ethnology. So easily might Lille be visited, and so well did the collection deserve further inquiry, that he strongly recommended his hearers to go there. In reference to the architectural portion of the drawings, he was sorry to find that Mr. Donaldson considered they were not, as he (Mr. Tite) had fondly hoped, the work of Michael Angelo. Mr. Donaldson had brought forward strong reasons in support of his opinion; and to his judgment and knowledge of the subject, he must at once defer. He had himself copied from one of the drawings the name of Michael Angelo, which was clearly written upon it; and it would be very easy to compare that with his undoubted autograph, so as to settle the question. One of the largest of the drawings appeared to him to be the first sketch of the great architect for the dome of St. Peter's, with the double cupola. He was informed at Lille that M. Wicar was employed by Napoleon Buonaparte in Italy, to collect works of art, and that in doing so he helped himself to these drawings, which he bequeathed on his decease to his native city. In addition to the interesting letter of Francis I. which Mr. Donaldson had read, he begged to read the following, from Buonaparte to M. Wicar, which was exhibited with the drawings; and which, notwithstanding certain peculiarities of diction, he had no doubt was dictated by Buonaparte himself, in 1796, from Milan.

Armèe d'Italie.

Republique Française.

Liberté, Egalité.

Au Quartier General.

Milan le 22 Prarial.

Au 4^{e} de la Republique—une et indivisible.

Bonaparte General en Chef de l'Armée d'Italie.

Au M. Wicart, peintre à Florence.

J'ai reçu votre lettre du 9 Prarial. Je 'ny ai point reçu les esquisses que vous m' vez annonciez.

Je vous engage a continuer d'occuper votre talent d'objets dignes de l'homme qui pense.

Je serai toujours fort aise de pouvoir de vous être bon a quelque chose.

BONAPARTE.

The sketches generally were singularly curious and beautiful; and he had been so much struck with them that he had contemplated interesting the architects of France, with a view to have them published in lithography; which might be easily and cheaply done; and he would suggest to the Council that they might

be able to promote this object. Whoever was the author of the sketches, he thought they might prove very useful in restoring the magnificence of ancient Rome. With regard to the Basilica of Constantine, he should be very glad to believe that there had been such a portico as the drawing referred to by Mr. Donaldson indicated. He believed, however, that both Palladio and Canina (the latter especially) were quite inclined to include a portico in their restorations of that building; but that it would be found that there could not have been such a portico, unless indeed the Via Sacra could be supposed to have passed within it. The Institute were under the greatest obligation to Mr. Donaldson for the attention he had given to the illustration of these works,—which were undoubtedly the production of some very clever man, if not of the great maestro himself.

Mr. Donaldson stated that he had intimated to M. Benvignat, who was a member of the Commission, having the care of these drawings, that he was sure the Institute would be much pleased to have tracings of them; but that gentleman believed this would not be possible, inasmuch as the Commission had the intention of publishing them very shortly. It would, however, be desirable to express the interest which this Institute felt in the matter, with a view of promoting that result.

Mr. Bell, M.P. Fellow, bore testimony to the extreme value and interest of the drawings, both in an architectural and artistic point of view. He had himself intended to revisit them, and prepared a paper on the subject; but he rejoiced that, in directing Mr. Donaldson's attention to them, he had ensured its being much more ably done.

The vote of thanks to Mr. Donaldson was then carried.

Some specimens of serpentine from the Lizard, Cornwall, were exhibited by Messrs. Brace and Colt. These specimens excited general admiration from their large size, high polish, and extreme beauty of colour,—and it was stated that the defects arising from the brittleness of the material, and its liability to decay, were almost entirely obviated when the stone was raised from some depth below the surface; in which case it was also procured in much larger slabs. Mr. Tite and Mr. Donaldson insisted upon the above defects in this otherwise beautiful material, as hitherto worked; but a hope was expressed that, with improved mechanical appliances, much better specimens might in future be brought into the market.

In answer to these observations, Mr. Brace gave a short explanation of the operations at the quarries referred to. He stated that he and Mr. Colt were the first persons who had ventured to open quarries of any considerable depth; that the experiment had been highly successful, stone having been obtained vastly superior both in colour and working qualities to any that had hitherto been produced; that there was every prospect of blocks of large size being readily obtained, of great variety in colour and general appearance; that the specimens shewn would compete in point of price with marbles of very inferior quality; and that there was no doubt that the objections that had been raised to stone obtained from the surface and the beach, portions of which had recently been used, would be entirely overcome, as stone of sound quality was readily obtainable from the lower depths of their quarries. Mr. Brace read an extract from the Geological Observer of Sir Henry de la Beche, in reference to the composition of the stone, to the following effect:

Taking the composition of serpentine and of olivine from the thirteen analyses, of each by several chemists, such as are given by Professor Nicoll in his Manual of Mineralogy, the similarity or difference would be as follows—

	Serpentine.	Olivine.
Silica	41 . 99	41 . 92
Magnesia	40 . 24	46 . 67
Oxide of Iron	3 . 38	10 . 75
Water	12 . 68	

The Meeting was then adjourned to the 28th of November.

ON THE APPLICATION OF PAINTED GLASS TO BUILDINGS IN VARIOUS STYLES OF ARCHITECTURE.

Read at the Ordinary General Meeting of the Royal Institute of British Architects, November 28th, 1853.

By C. Winston, Honorary Member.

In composing this paper on Painted Glass with reference to its employment in Buildings in various styles of Architecture, I have endeavoured as much as possible to keep in mind the practical objects of this Society. Many matters, therefore, of interest to the antiquary, will be passed unnoticed, or with a brief allusion to them—my object being, as far as I am able, to supply an answer to the question, What is the kind of painted glass best suited to a building of a given character?

On a question so wide and complicated, it is not only natural that very different opinions should exist, but extremely difficult to ascertain which is the most correct. The inadequacy of language to express ideas so subtle as those of which questions of taste are composed, must ever be an insuperable obstacle to bringing questions of taste to a certain determination by argument: a consideration which is condemnatory of the modern vice of dogmatizing upon such subjects. And the nature of the only remaining tribunal—the concurrent opinion of men of taste—that is of men who have given their attention to such matters, and whose views are respected by others engaged in the same pursuits—of itself sanctions a great latitude of sentiment. The feelings and habits, the education and temperament of individuals, even their natural appreciation of form or colour, all insensibly influencing their opinions on a subject respecting which there exists no definite standard. I am therefore very far from claiming any sort of infallibility for the views I am about to submit to your consideration—views which I shall attempt to support rather by calling your attention to objects with which you are already familiar, than by elaborate argument.

The variety of buildings which may require to be decorated with painted glass is great. Some are in the Greek, or Palladian styles of architecture, others are in the Gothic styles; and each building may be more or less grave or solemn in its aspect than others of its class. Such differences in the buildings demand, of course, corresponding differences in their painted windows. But before entering upon this topic, it will be convenient to declare what I believe to be the best subjects for glass painting, and the best mode of executing them. With regard to the mode of executing glass paintings, I will recall your attention to a paper which I read here, about a year ago, on the Methods of Painting upon Glass.* In which, after stating that there were three distinct modes of executing glass paintings, viz. by the mosaic method, in which the local colouring of the picture is produced by means of glass coloured in its manufacture, the shadows and outlines only being executed with an enamel colour; by the enamel method, in which the colouring of the design is effected by using enamel colours; and by the mosaic enamel method, by which the colouring of the picture is produced by a combination of the two former methods,—I concluded that the mosaic method was the best; because it was, from the nature of the thing, more favourable than either of the others to a display of the translucent quality of glass, and consequently of its brilliant and powerful colours—whilst, at the same time, it afforded the means of executing works as highly pictorial as the windows of the transepts and north chapel of Brussels Cathedral—works which maintain their superiority in point of effect, when compared with a series of later examples, including some of the most beautiful specimens that modern continental art can boast. This conclusion—for the soundness of which I must refer you to the paper I have named, and to the works of art therein mentioned—will confine our inquiry to what are the subjects best adapted for representation in glass paintings, executed according to the mosaic method.

* "On the Methods of Painting upon glass," read at the Ordinary General Meeting of the Institute, 7th March, 1853, and published in the Transactions.

These subjects may be divided into the following classes:—Patterns, similar to those used throughout the Mediæval period, and which usually consist of ornamental work in white glass, but sometimes of scrolls of foliage, either white or coloured, on a coloured ground. Pictures, where the objects are represented as seen in one plane, as in a bas-relief—such as we see in the painted windows of the 12th and 13th centuries; and pictures, where the objects are represented as occupying several planes, as in nature—such as we meet with in the painted windows of the first half of the 16th century; and, of course, compositions consisting entirely of such patterns or pictures, or partly of patterns and partly of pictures. To avoid any possible misconception, I should perhaps here state, that any reference to Mediæval examples in this paper is made only for the purpose of illustration, and not with any intention of conveying an impression that they are fit objects of imitation. Most valuable hints are doubtless to be obtained from an enlightened examination of such examples; but before we think of copying them, we ought to be quite sure that they are worth copying; and I will undertake to say that not one ancient example of painted glass, except, perhaps, those consisting of pattern work, can be considered as a perfect model for imitation. All, with the trifling exceptions I have named, of whatever date, are defective in one way or another, either in composition, drawing, or general effect. Even the finest cinque cento examples, which, taken collectively, are perhaps of all ancient examples the least open to criticism, were done at a time when the human figure was but imperfectly understood by the glass painters. And with regard to the often expressed notion, that it is better to submit to copies of mediæval examples than trust to modern invention, permit me to say that a more unjust imputation against the taste and skill of the 19th century never was made, or a more complete apology conceived for indolence and incapacity. Whose fault is it, I would ask, that low art, at least in regard to glass painting, should seem to be almost inseparably associated with what are called Church principles of architecture? Are not the patrons of the art to blame for indolently acquiescing in and sanctioning a mere system of copying, because they have not sufficient energy to study glass painting thoroughly, and make themselves acquainted with its principles? We may depend on it, if glass painting, or I may say art in general, had a practical bearing on the affairs of life, instead of only furnishing a means of amusement, we should no more hear of currency being given to such doctrines respecting it, than we now hear engineers advocating our going back to the single-condensing steam engine, or travellers by railway yearning for a return to the old horse tracks.

The patterns to which I have alluded, do obviously comply with the conditions of the mosaic method in the fullest and simplest manner; for the brilliancy of the glass is altogether unsubdued in these works, and the mechanical construction of the window is in harmony with their design—the leadwork connecting the pieces of glass, either forming an integral part of the pattern, or else actually constituting the pattern itself. I may illustrate my meaning by a reference to familiar examples, such as the Five Sisters, at York, and the geometrical pattern works, executed in white glass, so common in the 17th century, particularly on the Continent, of which engravings have occasionally appeared in the "Builder."

Turning from these, the works which next appear the most completely and simply to comply with the conditions of the mosaic method, are the pictures of the 12th and 13th centuries; for, of all pictures, these admit of the employment of glass of the most powerful hue, and the least diminish its brilliancy. Here also, the leadwork is made conducive to the effect of the design. It is true that in the cinque cento style we meet with pictures in which, as in a bas-relief, all objects are represented as occupying one plane as effectively as in a picture of the earlier period; but in no glass paintings is the bas-relief principle of representation effectively carried out with so much *simplicity* as in the pictures of the 12th and 13th centuries. This, I apprehend, is owing no less to the nature of the glass of which these works are formed, than to the composition of the picture. This glass, when compared with the glass used in later times, is remarkable for its apparent solidity—a quality which, without sensibly detracting from the brilliancy of the glass,

imparts great depth and richness to its hues. Hence the artists of that early period were able to leave large breadths of glass in their pictures unincumbered with any enamel colour—with which, in the mosaic style, as I have already informed you, the painting of the picture is performed—without incurring the risk of producing a weak or flimsy effect. We all are aware of the fact, that the shields of arms and the panel grounds, which in later years were so profusely adorned with diaper patterns, executed with the enamel brown paint, are in the works of this period usually left quite plain—the artists appearing to rely for effect on the tone and richness of the material itself. So we perceive, on examining a figure in any one of these early pictures, that whilst the deepest shadows are represented in the simplest manner by opaque lines, and the shadows in half-tint by a slight wash of enamel brown, the proportion of the glass left quite clear for the high lights, is much larger than in later glass paintings. That such a simple mode of execution, if applied to a more pellucid and watery material, must necessarily produce only a poor and flimsy effect, may be learnt from the modern copies of 13th century glass. But without dwelling on this point, I will call your attention to the composition of a 12th or 13th century picture, as of itself ensuring distinctness without the aid of any great breadth of shadow. This is simple enough: it consists in arranging the figures in one line, usually on a bar crossing the picture; in keeping the action of the figures as much as possible in the direction of the plane of the picture, and in insulating and separating the figures by the ground of the picture—a treatment, as you perceive, corresponding with that of an antique bas-relief. And since this treatment is in general more intelligibly carried out in the earlier examples, I think we may venture to ascribe it to the fuller influence of classical art at an early period of glass painting. In addition to this, as a general rule, the colouring of the figures is kept lighter than that of the ground of the panel. Of course these remarks are derived from an examination of a great many examples. I mention this, because I could easily contradict almost every one of them by a reference to particular works. It is from a majority of specimens only that a general principle is to be collected. The subjects to which I have just alluded are necessarily characterized by a certain archaic formality, arising from the stiffness of the colouring, and the simplicity of the design and execution. I have now to direct your attention to subjects of another class, as remarkable for their pictorial effect. I mean the picture glass paintings of the first half, or more correctly, of the second quarter of the 16th century. These works are in many respects the very opposites to those just described. Their colouring is harmonious rather than deep, and they are highly finished—peculiarities which I could shew to be connected with the nature of the glass employed in these works, which, without being as flimsy and pellucid as ordinary modern glass, is yet very inferior in depth and richness to that of the 12th and 13th centuries. Still these works will be found to comply with the conditions of the mosaic method, after making allowance for their different nature, equally with the works of the 12th and 13th centuries; and I hope I shall be able to prove that they are entitled to equal estimation. Their composition is various, consisting sometimes, as in the pictures of the 12th and 13th centuries, only of a line of figures occupying a single plane; but more commonly of a group—of *foreground* figures, it is true, but which in parts recedes from the eye: the figures not unfrequently occupying in plan, the arc of a semi-circle, as in some of Raphael's designs; and beyond the figures some distant object is usually represented, such as the sky, or a landscape. The picture, therefore, is designed on the principle of representing depth, and, in the best examples, is executed in such a manner as to produce the effect of depth. The means resorted to for this purpose are very simple. First may be noticed, the choice of such subjects as are capable, without a violation of probability, of being represented in a somewhat severe, if not harsh manner: thus a landscape, or a sea piece, a full idea of which cannot be conveyed without representing the graduated tints and soft outlines of nature, was never, at this period, selected as the *principal* subject of a glass painting. On the contrary, when a landscape background is adopted, it is used merely as an accessory, to set off and relieve a group of

foreground figures, in which all the interest of the composition centres. And, secondly, we may remark, that all the objects in the picture are represented as if they were seen under the influence of broad sunshine—a mode of treatment the most favourable, not only to a display of bright lights and sharp decided shadows, but to the general transparency of the picture, it being possible by this means to separate the various objects from each other, without having recourse to extensive masses of shadow or concentration of light, the use of which, however effective in the works of Rembrandt and other oil painters, is wholly unsuited to the conditions of glass painting, on account of its very limited scale of transparent shade. The heaviness resulting from the adoption of the opposite principle, of concentrating the light in the middle of the picture and keeping the rest in comparative obscurity, is shewn in the upper subject of the west window of New College Chapel, Oxford, and in the west window of Magdalen College Chapel, and in a variety of modern works; and the superiority of the sunshine principle becomes apparent on comparing these works with others in which it is adopted, as the windows of the North Chapel of Brussels Cathedral, those of St. Jacques Church, Liege, or the windows of Lichfield Cathedral.

A glance at the drawings on the wall, of portions of the glass at Brussels and Lichfield will explain my meaning better than any words I can employ. We there see, that the figures are cut out from the background, and the architecture from the sky or landscape; as much by the opposition of light and shade, as by the local colours: and thus the crispness and clearness of a sunshine effect is not only highly conducive to the brilliancy of the window, but is most favourable to the concealment of the leads, which form part of and are wholly lost in the sharply defined shadows with which the foreground objects are bounded, and even in the background are on a close view not unfrequently absorbed in the colouring, but at all events pass unobserved in the general crispness of the picture, when it is viewed from the proper distance. Of course I am not speaking of the broad modern lead, used in repairs of old glass, but of the ancient leads themselves, which never until almost the beginning of the 17th century exceeded $\frac{3}{16}$ of an inch in width. In cinque cento glass paintings therefore, the leadwork forms an integral part of the design, equally as in a 12th or 13th century picture. And these works also evince a thorough compliance with the mosaic system in preserving the translucent qualities of glass. A cinque cento glass picture, notwithstanding the power of its shadows and high finish, which entirely save it from the charge of weakness or poverty, is still a brilliant and diaphanous glass picture; owing, partly to the crisp treatment alluded to, partly to the care taken to leave considerable portions of the glass, though not such relatively large portions as may be seen in the works of the 12th and 13th centuries, unencumbered with enamel brown. But without going further into the minutiæ of the subject, I will ask any one accustomed to compare glass paintings of different dates, whether in any so high a pictorial effect has been produced with so little diminution of brilliancy, as in the works of the 2nd quarter of the 16th century.

You will perceive that from this summary I have omitted all notice of glass paintings of the 14th and 15th centuries. I have done so from a conviction that the nearest approach to an artistically flat style of representation is to be found in the works of the 12th and 13th centuries; and that the nearest approach to an artistically rotund style of representation is to be found in the works of the second quarter of the 16th century: and that there is nothing to choose between a really flat and a really rotund style. At first sight there is, I admit, but little difference between a 13th century and a 14th century picture, in point of composition; but a closer examination generally brings to light various minute differences, tending to shew, either that the artists of the 14th century were already contemplating a change from flatness to rotundity of representation, or that they did not strictly adhere to their predecessors' rules for ensuring distinctness in a flat style. The inconsistency, not unfrequently seen in works of the 13th century, of representing the figure in relief, but omitting to indicate the recess of the niche in which the figure is supposed to stand—a mistake which perhaps arose from imitating in glass too literally the designs of

ancient goldsmiths' work, where, as every body knows, embossed figures are often stuck on a flat ground, having architectural forms drawn in outline upon it—is repeated and exaggerated in pictures of the 14th century. Indeed, most of the 14th century groups that, according to the usual fashion of the day, are surmounted with shrine work, look just like groups painted on flat panels, fringed by way of ornament with spires and crockets; so completely does the apparent flatness of the canopy—rendered no doubt more conspicuous by the increased elaboration of its details—correspond with the flatness of an ordinary panel. And the figures themselves, owing partly to the increased breadth of their draperies, inattention to the principle of insulating them by means of the ground colour of the panel, and a bad selection of the colours of the drapery, certainly do not in general appear at a distance so distinct as the figures in a 13th century picture. I therefore cannot but regard the 14th century style of glass painting as inferior to the 13th, and the 15th century style as inferior to that of the 14th. The 15th century was evidently passed in the effort to get out of a flat style of representation into a rotund one. It is true that all the pictures of this period appear to be flat, but they are flat in effect only, and not on principle; their flatness is the result of imbecility, not of design. They are designed as much on the principle of depth as a cinque cento glass painting, but they do not, like it, produce the effect of depth, because their designers were ignorant of the means of attaining the desired result. As in a cinque cento glass painting, so in one of the 15th century, the figures are not unfrequently arranged on the arc of a semi-circle, and are not cut out or separated from each other by stiff colour. And that the intention was to represent depth is plain from the representation of distant objects, of sky and landscape, coloured with considerable regard to the hues of nature; but, contrary to the practice of the cinque cento artists, the shadows are sometimes misplaced, and are always too weak; and the gradations of colouring, though such gradations might have been as easily made as in cinque cento work—the nature of the material being the same in both cases—are not sufficiently attended to. Hence the glass pictures of the 15th century, beautiful as they sometimes are in detail, remind one in general of an assemblage of court cards. They frequently produce no other effect, even at a moderate distance, than that of a mosaic composed of strangely-shaped pieces of glass of various colours. I think, therefore, that we may leave the works of the 14th and 15th centuries as objects chiefly interesting to the antiquary.

Having thus indicated, as briefly as I could, the sort of subjects which appear to be most suited for glass paintings, I will endeavour to shew what sort of glass paintings are best suited for particular buildings. And here the real difficulty of the subject may be said to commence; for since no example of contemporary glazing is to be found in any building earlier than the middle ages, it is only by analogy that we can arrive at the fitness of painted glass for classical buildings, if we rely on experience as a guide; and in a matter of this sort, I fear there is no guide so trustworthy as experience. It will be admitted, I apprehend, that the earlier Gothic styles are more severe in their architectural character than the later ones; and I think that you will likewise admit, on reflection, that the glass most in harmony with Gothic buildings in the Norman or early English styles, is that of the 12th and 13th centuries. I have tried for a long time past to discover the reason of this conformity, and have arrived at the conclusion that the harmony between the painted windows and the architecture depends far more on the colouring of the windows than on their design. I have often contemplated the general effect of 13th century, of 15th century, and even of 16th century painted glass, in the windows of a Norman or Early English building, from a distance too great for admitting of my making out the design with any degree of distinctness, and have invariably observed that the colouring of the earlier glass most accorded with the character of the architecture, and that the harmony was the same, whether the windows were almost entirely formed of white glass, like the Five Sisters at York, or were richly coloured, as at Bourges or Canterbury. As might have been expected, I have not met with the same opportunities of contrasting the effect of 13th century painted glass with that of the

15th or 16th century, in reference to its harmony with the architecture of the 16th century, but such experiments as I have been able to make have tended to create an impression on my mind, that the glass paintings of the 15th and 16th centuries do harmonize more completely with the character of the architecture of the 15th century than the glass paintings of the 13th. However, without pressing the last point, I will venture to express a firm belief that the colouring of a 16th century glass painting does harmonize better with the character of a building in the Renaissance style, than that of a 13th century glass painting.

In these conclusions I would beg you to observe that I have been influenced by the general effect of the glass painting, rather than by its force, because I have remarked that good cinque cento glass paintings, which are hardly if at all inferior in power to Early English ones, do not in general harmonize with 13th century buildings so completely as the windows of the 13th century. The inference I draw from these experiments is, that there is an analogy between the colouring of 12th and 13th century windows, and buildings remarkable for the gravity and solemnity of their appearance. And this, when the nature of the colouring of these windows is analysed, will I think be found to accord with Sir Joshua Reynolds' views. He says in his 4th discourse, "with respect to colouring, though it may appear at first a part of painting merely mechanical, yet it still has its rules, and those grounded on that presiding principle, which regulates both the great and the little in the study of the painter. By this the first effect of the picture is produced, and as this is performed, the spectator, as he walks the gallery, will stop or pass along. To give a general air of grandeur at first view, all trifling or artful play of little lights, or an attention to a variety of tints, is to be avoided. A quietness and simplicity must reign over the whole work, to which a breadth of uniform and simple colour will very much contribute. Grandeur of effect is produced by two different ways, which seem entirely opposed to each other. One is by reducing the colours to little more than chiaro-oscuro, which was the practice of the Bolognian schools, and the other by making the colours very distinct and forcible, such as we see in those of Rome and Florence. But still the presiding principle of both those manners is simplicity. Certainly nothing can be more simple than monotony: and the distinct blue, red, and yellow colours, which we see in the draperies of the Roman and Florentine schools, though they have not that kind of harmony which is produced by a variety of broken and transparent colours, have that effect of grandeur which was intended. Perhaps these distinct colours strike the mind more forcibly, from there not being any great union between them; as martial music, which is intended to rouse the nobler passions, has its effect from the sudden and strongly marked transitions from one note to another, which that style of music requires; whilst in that which is intended to move the softer passions, the notes imperceptibly melt into one another." Now if we compare the colouring of a 13th century glass painting with that of a cinque cento one, we perceive that the colouring of the former consists of an assemblage of powerful, distinct, positive tints, skilfully arranged, but more on the simple principle of a mosaic, than on the more blended principle of a painting. Whilst the tints of the latter are less forcible, less decided, and more blended together. I have seen some cinque cento glass pictures in which there is no red, and but little positive blue, the colouring being almost entirely composed of secondary tints, and in which the transition from one tint to another, is scarcely more marked or sudden, than is the case in some of Titian's pictures. These considerations may perhaps be sufficient of themselves to justify the opinion that the colouring of an Early English glass painting is more calculated to produce a grave and solemn effect than that of a cinque cento one; but in acceding to this opinion we ought not to overlook the fact, that the tone of colour of an Early English glass painting is cool, and that the tone of colour of a cinque cento glass painting is warm, and that a cool tone of colour of itself has a tendency to produce a grave effect, and a warm tone to produce a gay effect. If these views are correct, it follows that we ought not only to continue to employ for the windows of 12th and 13th century buildings, glass paintings similar to those of the 12th and 13th centuries, as regards the tone and principle of the colouring, but that we ought to glaze in a

similar manner, the windows of all other buildings which can be said to possess an air of gravity and solemnity equal to that of a 12th or 13th century building: using of course, weaker colours, warmer tones, and a more elaborate mode of execution for the windows of buildings in a less severe style. Some people are of opinion that in no style but the Gothic can so solemn an effect be produced, but it seems to me that the solemn character of a building, depends rather on its plan and arrangement, than on the style of its details. A Norman cathedral is as solemn as a Gothic one, and parts of the Coliseum at Rome are, I am told, as gloomy and solemn as the aisles of a Norman building. The rule therefore might well apply to certain ecclesiastical buildings in the Roman style of architecture, and I see no reason why it should not equally apply to certain ecclesiastical buildings in the Greek style: certainly these buildings, owing to the simplicity of their plan, do not possess the gloomy effect of a Gothic cathedral, but the extreme severity of the architecture imparts to them an air of gravity and solemnity, which I apprehend is rarely equalled by a 12th or 13th century building of corresponding dimensions.

I am quite aware that the employment of rich and deep colouring in windows has a tendency to diminish the apparent size of a building, and I am ready to admit that it is to a fear of producing this result, that we may attribute the modern practice of decorating the windows of a Greek building, with glass too faint in its hues to rescue it from the imputation of washiness. But it is by no means necessary to go into the opposite extreme. A glass painting entirely composed of white glass, would harmonize with the character of Greek architecture equally as one principally composed of coloured glass; provided that the white glass was, like that of the 12th and 13th centuries, solid in appearance, and had a rich cool tone. And even when the employment of a larger proportion of coloured glass might be desirable, it would always be possible to make the window recede from the eye, by using in it a predominating quantity of blue and white. But whether the advocates for powerfully coloured, or for white windows, as being most in keeping with the character of a Greek building, are right, I trust that all will agree in preferring rich tints to poor ones. Had the ancient Greeks glazed their windows, we may be certain that they would have used glass of rich tint, whether it was white or whether it was coloured. For amongst all the ancient Greek glass vessels that I have examined, I have never met with any of a poor tint, or flimsy appearance in point of colour or texture of the glass. And indeed so closely does the glass composing these remains resemble in its appearance and chemical analysis, the window glass of the 12th century (from which that of the 13th differs but little) that were I desirous of forming an idea of what Greek window glass would have been like, I should endeavour to call to recollection the tints of Suger's glass at St. Denys, or that of the glass in the W. triplet of Chartres. And besides, the remains of strong colour used in the decoration of ancient Greek buildings, leads to the inference that the ancients, had they used window glass at all, would have employed that possessing a rich tint, from choice as well as necessity. We are still less without authority to guide us in regard to the design for windows proper for ecclesiastical buildings in the Greek or Roman style of architecture. The views I have expressed with reference to the colouring of these windows, must confine me to an advocacy of a simple flat system of representation, because pictures composed on the principle of representing depth, cannot properly be executed in glass entirely consisting of strong rich tints. The only attempt I have hitherto seen at designing windows for a Greek building, is at the Church of St. Vincent de Paul at Paris. But however worthy of notice these windows may be as an embodiment of a new idea, they are neither sufficiently delicate in design, nor simple in execution, to serve as models for our imitation. It is very possible that this defectiveness may be in a great measure attributable to the thinness and watery character of the glass of which they are composed, and to the efforts of the artist to disguise the badness of the material by a more elaborate execution; but such expedients are no longer necessary, since as I have before informed you,* the manufacture of 12th century glass has been

* See paper "on a revived manufacture of coloured glass used in ancient windows," read at the Ordinary General Meeting of the Institute, 14th June, 1852, and published in the Transactions.

revived; and which I have always considered the more fortunate, on account of the use that might be made of it, in the embellishment of classical architecture, consistently with which, unlike the Gothic, art may be fully developed. There can be no doubt that valuable hints might be derived from an examination of the designs of ancient sculpture, and even of tessellated pavements. Indeed classical designs, admirably adapted for glass paintings, are engraved from sculpture in Pistolesi's Vatican, the most remarkable one is given in the 2nd vol, plate 3,* These designs consist of figures and ornaments in one plane, and therefore if executed in glass, as I have recommended, would a good deal resemble some of the works of the 12th and 13th centuries. These mediæval works, must appear to the most careless observer to be defective in many respects, particularly in relief. When viewed closely, the intention of the artist to bring out the various projections of the figure and drapery, by means of strong black lines, is often admirable, especially as seen in the heads of the figures; but, sometimes from want of boldness, sometimes from a want of knowledge where to place the shadow, early English figures in glass, when viewed from a little distance, are too apt to appear like flat surfaces; quite as flat, if not more so, as the men and horses appear to be in those copies of the inner frieze of the Parthenon, which, placed in situations distant from the eye, and exposed to the influence of full light, are used to decorate the outsides of some of our public buildings. I am far from agreeing with those who contend that no greater relief ought to be imparted to a simple flat glass painting, than is given to those flat relievi from the cella of the Parthenon. For those who urge such views, seem to have entirely overlooked the original situation of these relievi, placed where no direct light could reach them. To use the words of one of our most accomplished artists: "it is a great mistake to suppose that the flat style of relief was intended to appear flat, and it is a great mistake to apply it in situations, as in the open air, where it must appear so, and be indistinct besides."† In accordance with this authority, I will venture to say, that quite as much relief ought to be given to the figures in the simplest and flattest glass painting, as is given to the alti relievi in the metopes of the Parthenon, which were intended to be seen in the open air, and from a distance. I throw out these observations however, rather with reference to those who may be about to design simple flat glass paintings for mediæval buildings. For since I am perfectly sure that none but first-rate artists can design windows fit for classical buildings, I may well be content to leave the matter entirely in their hands: and can only express my surprise that a field so favourable to a display of the highest art, should have been so long neglected. Flaxman's labours sufficiently shew the possibility of employing the exquisite language of the ancients to express true christian sentiment; and some of his choicest designs might advantageously be reproduced in painted windows for classical buildings, were it only by way of proving to the public, what works of art painted windows might become in competent hands.

I shall trouble you with but few remarks on the selection of glass paintings for buildings in the Palladian style of architecture, in which I would include all Wren's churches, and even St. Paul's itself; for though that building has in parts a Roman severity, its interior in particular, bears many marks of the taste of the 17th century, especially in the ornamental details. Such buildings taken on the whole, are less severe in character than true Roman or Grecian buildings, and therefore would seem to require a corresponding relaxation in the character of their painted windows. In my opinion, no greater mistake is committed than when a stiff Byzantine style of decoration is applied to the windows of a Palladian building. I have heard it defended on the ground that since such glass would harmonize with the character of a Roman building, it ought equally to harmonize with the character of a Palladian one—because both styles of architecture have a common origin—in the old Roman: an argument which is at once disposed of by the remark, that the Romanesque style betrays its more immediate origin, in the Greek character of its

* "Il Vaticano descritto ed illustrato da Erasmo Pistolesi,"—Roma, 1829; see also vol. 5, plate 81, and vol. 2, plate 4.

† "Contributions to the Literature of the Fine Arts," by Sir Charles Eastlake, Pres. R.A., p. 104.

ornaments, and some of its mouldings, from which character the Palladian is free. I have also heard it defended on the supposed necessity of imparting a more religious air to a Palladian church. But surely there must be other and more legitimate ways of increasing the solemnity of a building, than by the introduction of incongruous ornaments and decorations, which oppress the architecture by their severity. Who would think of encrusting the walls of St. Paul's Cathedral with stiff Byzantine mosaics? I believe that it is amongst the works of the cinque cento period that the true models for painted windows suitable for Palladian churches are to be sought. Amongst these works, as has been remarked, many varieties of design and character may be seen. Some are more solemn and grave than others, but the blended, and comparatively undecided colouring of even the most simple, renders them less solemn and severe than the ordinary works of the 12th and 13th centuries. In most matters of detail also, cinque cento glass paintings accord with Palladian architecture. So that on the whole, the cinque cento style of glass painting, as developed in its best specimens, seems more suited than any other known style for the windows of Palladian buildings.

In adopting this style, the glass painter, as before-stated, is by no means confined to the use of pictures having receding backgrounds, but may use as flat a composition as a line of well relieved figures, placed in front of a sheet of tapestry: or even, in small works, or in the accessory parts of greater works, would find authority for the employment of well relieved figures on perfectly flat coloured grounds. The use of receding pictures in painted glass in any building, of any style, has however been strenuously objected to; and the present seems a good opportunity of inquiring a little into the validity of the objection.

It proceeds, as far as I can understand, on two grounds. The first being, the supposed unfitness of the material for any sort of representation more pictorial than the mosaics of the 12th and 13th centuries. The second, the supposed impropriety of representing a receding picture on the wall of any building. In support of the first ground of objection, we are told that a glass painting reverses the conditions of nature, by making the lights transparent, and the shadows opaque; that the violence of its colouring is wholly opposed to pictorial effect, and that to bound objects with black lines is reprehensible on every artistic consideration. The first of these arguments is at once disposed of by the observation, that we have nothing to do with anything but the *effect* of a glass painting; and that when the material is, like that of the cinque cento period, of a horn-like texture; the high lights do *not* appear to be less solid than the shadows.

With regard to the two other objections, I admit that they would be unanswerable, if it was true that an artist was precluded from painting a picture under any other than the most favourable conditions. But to assert this would be to fly in the face of all authority—and what is worse, to contradict all experience. According to such a rule, Raphael was blameable for making designs such as the Cartoons, to be worked in tapestry—"a mode of representation," says Sir Charles Eastlake, "which in the early part of the 16th century was far from exhibiting even the comparative force of colour, and light, and shade, which it afterwards attained." He should, according to the above rule, have condescended to no means of representation less complete than what oil painting affords. Nevertheless, his availing himself of such restricted means of representation, which doubtless was imposed on him by some necessary condition, so far from being made a matter of imputation, has but increased the reputation of the artist. To use again the words of Sir Charles Eastlake, whose admirable Essay on the Styles and Methods of Painting, should be carefully read by those who interest themselves in glass painting,—"With a view to such faint transcripts (the tapestries) the great artist worked. He knew that his drawings would be transferred to them, and that in the tapestries alone, possibly, his designs might live. Distinctness was nevertheless attained without any sacrifice of such of the proper attributes of painting as were compatible with the means employed, and without any violation of probability. When we consider the great qualities which were combined with

these requisites,—when we find that such apparently unpromising conditions had the effect of raising even Raphael above himself, we can hardly refuse to admit, that a due employment of limited means of representation may at least invite attention to the most important attributes of art." * Unless therefore the conditions of glass painting are so opposed to pictorial effect, as to render the attempt to produce it nugatory, I can see no possible reason for an artist declining to fill the windows of a building with pictures, in which the art of representation is carried further than in the glass paintings of the 12th and 13th centuries. In many cases it might be extremely desirable that he should do so—for there are subjects, very proper to be represented in places of worship, which are either wholly incapable of representation in a simple flat style; or when attempted to be so represented, only prove how easily the line which separates sublimity from absurdity may be overstepped. But when pictures in painted glass, representing receding objects, actually do exist, in the contemplation of which we forget the limited means the artist had at command, and in which excellencies are discovered, such as are unattainable except in a painted window; the ground of objection to which I have addressed myself appears to fail altogether.

The remaining objection, that it is wrong to represent a receding picture on the wall of a building, and consequently in a window, the glazed surface of which is but a continuance of that wall—seems to rest less on a consideration of facts, or the dictates of our external senses, than on a sort of mock philosophy, which seeks to escape laborious investigation, by the enunciation of a "principle"—than which, by the way, nothing is more easy. It may be conceded that to carry a receding picture all round a room produces an ill effect. But pictures, though representing the effect of depth and distance even almost to illusion, are admitted to be allowable, provided they occupy only a portion of the wall, either by being hung against it in a frame, or by being actually painted upon it,—the latter sort indeed can plead the testimony of ages in its favour. If then a glass painting should have the illusion of distance, it would be unobjectionable,—because, necessarily, it could occupy only part of the side of the room or building containing it. And as we are accustomed to see out of a building, by looking through its windows, those who mistook the painting for a real object, might easily stretch the imagination a little further, and conclude that it was some object placed outside the building, until its unreality became apparent from the figures continuing to remain motionless. But, in truth, I suspect that no one ever mistook the representation of any object in a painted window, not even a landscape, for the reality, or except whilst his attention was exclusively devoted to the painting, imagined that his view extended beyond the limits of the building: a feeling which for the moment might be equally excited by the contemplation of a picture hung in a frame against the wall. The instant the glass painting was regarded with reference to the building, it would be perceived to be nothing else than a coloured superficies, whose plane lay in the same direction with that of the wall in which it was inserted. It might indeed sometimes happen that for the sake of preserving distinctness at a very great distance, a glass painting, in which figures were represented on a flat ground, would be preferable to one having a receding background. But I think that the glass painter need be deterred by no other consideration from employing a receding design, if he thought proper. Indeed, a glass painting having a sky or landscape background, such as we meet with in good cinque cento examples in general, would be peculiarly suitable for a window at the end of a building, on account of the retiring nature of most of its hues. I conclude therefore that in the preparation of painted windows for classical edifices, the artist has the choice of a more or less severe style of representation, to be used according to the character of the building he is required to decorate; and that the type of the one style is to be found in the remains of 12th and 13th century mosaics, and that the type of the other is to be found in the glass paintings of the second quarter of the 16th century. The artist might, I apprehend, be guided by similar principles in preparing painted windows for buildings in the Gothic styles.

* "Contributions to the Literature of the Fine Arts," by Sir Charles Eastlake, p. 133.

I have already stated my belief that the glass paintings of the 12th and 13th centuries are most in harmony with the architecture of those respective periods, and therefore think that such of those works as most consistently carry out the simple flat style of representation ought to be regarded, with but few exceptions, not indeed as objects to be reproduced in copies, but as guides to assist the artist in forming new and original designs. The principle of an ancient composition might be more strictly adhered to now than at any former period, on account of the revived manufacture of the window glass of the 12th century; but this recommendation would by no means involve the necessity of copying the object itself. Indeed nothing is more thoroughly opposed to sound sense, and good taste, than a mere servile copy of an ancient glass painting, or a copy with such trifling modifications as to be little else than a servile copy. If intended as a counterfeit, it must fail in its object—for none but the inexperienced are likely to be deceived by it—and once known to be a counterfeit, it would lose all interest from association with bye-gone ages. If intended to pass for nothing more than a copy, under the bonâ fide impression, that nothing except a copy of ancient painted glass will harmonize with Gothic architecture—it serves but as a cover for indolence—it can advance nothing, because a copy is sure to fall short of the original in all real merit; and besides this, its production amounts to an unconscious satire on Gothic architecture, when we consider the imperfect state of the art of representation as displayed in ancient windows. The only true course is to treat every modern work in painted glass, as an original work of the 19th century,—and as such, to test it according to intelligible rules of taste. The inquiry ought no longer to be confined to the narrow issue of conformity with some ancient authority, but should extend to a consideration of its intrinsic merit as a work of art, and its extrinsic merit as being in harmony with the architecture with which it is associated. To prescribe so wide a field of inquiry might, indeed, prove inconvenient to certain critics, but would certainly tend to a more zealous investigation of the principles of ancient art than heretofore, and to the production of works more worthy of the 19th century: in short, it is by this means only that any progress can be made. A 19th century window, designed for a 12th or 13th century building, ought not only to harmonize with the architecture in the quality and treatment of its colouring, but besides restraining conventionality within due bounds, should likewise be free not merely from the bad drawing, but from the quaint and contorted attitudes of the figures of the 12th and 13th centuries; attitudes which, however fashionable they might have been at that period, are shocking to our present tastes and feelings. It should, in fact, reproduce nothing but the art of that period, the genuineness of which will only appear the plainer, when the film of bad taste and deformity is stripped from it, through which we are now obliged to penetrate before we can fairly see it. I should add, that in designing a window for a 12th century building, the artist can never do wrong in going at once to the fountain head, and correcting his taste by the remains of classical art, whose influence is so easily recognised in the glass paintings of the 12th and 13th centuries.

A consideration of the colouring best suited for the windows of a 14th century building presents an interesting subject of inquiry, but into which I cannot, for want of time, particularly enter. The glazing of the 14th century, until about the year 1380, in respect of the quality and disposition of its colouring, holds in general a sort of middle place between the rich mosaics of the 13th century and the paler picture glass paintings of the 15th century. Its individual colours being as cool, and almost, if not quite, as powerful as those of the 13th century—but being intermixed with a much larger proportion of white glass, and used in broader masses. But this difference in the character of the colouring seems attributable rather to the nature of the designs which became fashionable in the 14th century, than to any definite abstract principle. But however this may be, there is one lesson to be learnt from the works of the 14th century, if not from those of the latter part of the 13th, which is—that the glazing which chiefly consists of white glass is more favourable to the effect of window tracery, than that which consists of a mass of intensely rich colours. For the latter tends to confuse the tracery, unless indeed the direction of

the principal lines of the glass composition are strongly opposed to the lines of the stonework, in which case there is a sufficient contrast between the stone tracery, and the deep coloured glass, to render the former perfectly distinct. Thus the mullions and tracery come out strongly in some of the clerestory windows at Bourges, and in the windows of York Chapter House, where the glazing is principally white, but are not so easily made out in the windows of the Sainte Chapelle at Paris, which are filled with richly coloured glass. On the other hand, the mullions of the southern rose at Chartres, which is likewise filled with richly coloured mosaics, shew themselves distincly—as appears from the diagram I now exhibit. Here the principal lines of the stonework diverge, like rays, from the centre of the window, whilst the principal lines of the glass composition form concentric circles. The star-like effect of this, and many other rose windows of the 13th century (the north rose of Nôtre Dame at Paris, is another example); thus being produced by the opposition of two distinct designs,—one of which, the stone design, appears as if it was laid upon the other. If this consideration should lead to the conclusion that glazing, principally consisting of white glass, is best suited for the windows of buildings in the Decorated style of architecture, there can be little doubt, I apprehend, that the best designs would be those consisting of pattern-work painted on white glass, of which there are numerous and beautiful examples in the Cathedrals of York and Exeter, Merton Chapel, Oxford, and other places, with or without the enrichment of inserted panels, containing groups, or single figures, on stiff coloured grounds, executed in the simple flat style before-mentioned. I would on no account advocate the use of figures and canopies, because the stiff character of the colouring, which does not materially differ from that of the 13th century, is unfavourable to such a display of light and shade as is necessary to make the canopies seem as if they projected forward. I have heard the flatness of decorated figures and canopies defended on the score of their resemblance to some of the published outlines ofthe German engraver, Retsch; but these outlines are only intended for near inspection, by which alone, the varying thickness of the outline, which produces the effect of light and shade, can be appreciated. At a distance, these designs would, of course, be invisible; or if enlarged in painted glass, as I have also heard recommended, would appear flat and thin: just as a copy of a 14th century monumental brass would look if executed in painted glass.

The change in the nature of the material in 1380, or thereabouts, and the substitution of glass, such as we see used in the works of the 15th and 16th centuries, for the deep intense tints previously employed, is, like many other points connected with the history of an art, one on which no light has hitherto been thrown. It is but a conjecture that the change was brought about by the glass-makers in Germany. But I think we may conclude, from the fact that glass painting was becoming more pictorial just before the change in the material, and that it became still more pictorial after it, that the lowering of the different tints in depth, was intended to second the efforts of the artist to produce glass pictures in preference to glass mosaics. One is tempted to infer the existence of some harmony between the character of the architecture, and the delicate tints and silvery tone of the glass of the 15th century, from their having been so long associated together. And, in one respect, the glass is no doubt well suited to the architecture. For even the most elaborately painted window is, owing to the lightness of its hues, never confused with the stone-work. And experience has abundantly shewn that the effective pictures of the 16th century harmonize as well with the architecture of the 15th as the imperfect productions of that period. There is no apparent difference between the architecture of the windows of Fairford Church, Gloucestershire, and that of the windows of churches quite half a century earlier; and yet the 16th century glass, with which these windows are filled, is in perfect harmony with the character of the building. I therefore think that windows for 15th century buildings should be designed on the model of the glass paintings of the 16th century; in which case the artist might consistently employ canopies, if he thought proper. The most splendid Gothic canopies in glass, that I have ever seen, are in two of the windows of Munich Cathedral; one is dated 1503.

These canopies are so painted as to appear like what they profess to be—hollow niches. As a general rule it appears more satisfactory that one scale of figures should be preserved throughout a window, than that the size of the figures should be regulated by the sizes of the lights they occupy; as in most Gothic examples. In the cinque cento period the uniformity of scale was preserved, not unfrequently, by the employment of angel boys, instead of full grown figures, to fill the smaller tracery lights. At Fairford, and other places, the expedient adopted is the use of demi figures in the tracery lights.

In the 15th as well as in the 16th century, it was a not uncommon practice to extend the designof a glass painting beyond the limits of a single light. In some instances the entire window is filled with a single picture, which is spread over the whole opening, independently of the mullions. So great an outcry has however been raised against this practice, that it seems worth while to say a few words in justification of it. In the first place, there is not, I conceive, a greater violation of principle committed, in laying as it were the design of Perpendicular tracery work, over the design of a 15th century picture in glass, than is committed in laying the design of a 13th century rose window over the design of its glazing. The stonework of the window sustains no injury of effect, on the contrary it is rendered more distinct by the opposition of its design to that of the glass. Neither is the glass painting injured by being cut by the stonework, for as remarked by a member of this society on a former occasion, the force of imagination is such, that the design may be preserved in all its unity, through any number of lights: an observation which, I think, will be admitted to be true by those who have been in the habit of looking at such works with an unbiassed eye. But the practice may be defended on another, and perhaps less questionable, ground—on the score of necessity. Our ancestors were in the habit of representing in their windows vast numbers of legendary saints: but modern practice is in general so opposed to this, as in effect to limit the choice of the artist to representations of our Saviour, the four Evangelists, the twelve Apostles, occasionally the Virgin Mary, and some of the Prophets and Patriarchs. I believe that I am speaking within compass when I say that his choice does not extend beyond three dozen single figures. Consequently monotony is inevitable, unless recourse is had to groups of figures. Here indeed the means of selection is almost unlimited. Flaxman declares (Works, p. 337), that it may be affirmed "without danger of exaggeration, that many hundred subjects are to be found in the sacred writings, which, being ably designed, would be *new* to the beholder." But in order to ensure a sufficient scale for the figures, the group must not unfrequently be extended beyond the limits of a single light. Upon the ground of necessity, therefore, we may well justify the carrying a glass picture across a window, to a certain extent irrespective of the mullions. And I should perhaps add, that when we consider that painted windows by their size might not unfrequently offer a field for the talents of the historic painter, it seems unadvisable to scare artists from it, by imposing conditions, which were often broken through by the mediæval painters themselves.

In conclusion, I will repeat what I stated at the outset, that I claim no infallibility for any of the views I have advanced. I am conscious of having approached delicate ground more than once; especially in the course of my remarks on the sort of glass paintings best suited for buildings in the classical styles. On this point I consider that I have but raised questions which wiser heads than mine must solve. My object will have been accomplished if I have added but one grain of information to the common stock: or if I have succeeded in proving that there is no mystery in glass painting; that it is a branch of the Fine Arts, distinguished from others only by certain conditions, and that the same sober rules of criticism equally apply to the productions of the glass painter. To take a familiar instance—we sometimes hear it disputed whether the flesh ought to be coloured or left white, in a glass painting; the opponents of tinted flesh urging the impossibility of imitating nature exactly in this respect. The answer is obvious enough. The whole colouring of a glass painting is highly conventional, whether it be of the draperies, of the flesh, of the sky, or of any other object; still so long as it does not exceed the limits of conventionality—a point to

be ascertained only by observation and general opinion—the eye and imagination are satisfied. We should be startled and disgusted at seeing flesh painted green or blue, but the complacency with which pink or white flesh in a glass painting is regarded by the generality of mankind, is a sufficient proof that neither of those tints contradicts nature too violently; and therefore, that the artist does not exceed the limits of conventionality in using either white or tinted flesh, at his discretion. The wide range of this paper, and the necessity of confining its length within reasonable limits, has of course compelled me to touch on several topics in a very cursory manner; and especially that relating to the actual mode of executing a glass painting, on which the argument in favour of the mosaic system almost entirely depends. However as I went into this subject at great length, in a little work which I published in 1847,* and of which there is a copy in your library, I must refer those to it who are inclined to pursue the matter further. It may seem superfluous to those who have read this book, to assure you that there is a perfect consistency between it and such views as I have just expressed; but as certain writers are in the habit of taunting me with inconsistency, I may as well state that the only foundation for the charge is this—That perceiving at the time when that book was written, that modern copies of the 13th century windows, besides being very raw in colour, were, owing to the extreme pellucidness of the glass then in use, thin and poor in effect—the most favourable examples never having a more imposing air than a *veneer* of an old window might be expected to have, and that the process of antiquating the glass, that is dulling it over with enamel brown in imitation of the effect of age, only produced dulness without imparting depth—I ventured to suggest the adoption of shadows, such as we see in cinque cento work, as well as a broader style of colouring than was used in the mosaics of the 13th century, as a means of correcting the flimsiness, without destroying the brilliancy of the material, and at all events of giving *power* to the work. And that since the manufacture of the 12th century glass has been revived, I have advocated a nearer approach to ancient precedents, both in the execution of the painting, and the method of its colouring. I trust this brief explanation will finally dispose of the charge to which I have alluded; a charge which never would have been made, any more than the absurd misrepresentation, that I have at any time recommended the universal employment of the cinque cento style, details and all, had it not been for those writers' ignorance of the subject on which they professed to write, and their consequent inability to comprehend any argument in relation to it, which is founded on general views. To you, gentlemen, I am indebted for the patience with which you have listened to so long and dry a discourse.

The Chairman, Mr. T. H. Wyatt, V.P., having adverted to the great interest and importance of the subject, especially in the novelty and boldness of some of Mr. Winston's views, suggested that the discussion of the paper might be advantageously postponed until the next meeting, when he hoped that gentleman might be able to attend.

Mr. Winston having assented to this suggestion, it was agreed that the discussion should take place at the Meeting on the 12th of December.

M. Rochas exhibited some specimens of stone, prepared and hardened by a new process, to resist the effects of the atmosphere.

Mr. G. G. Scott, Fellow, suggested that a Committee should be appointed by the Institute to consider thoroughly the subject of the prevention of decay in building stone. Architects were obliged to use soft stones, which sometimes proved durable in country places, whereas they decayed rapidly in the metropolis. Caen stone had not been found to stand as it did in former times; and if, as M. Rochas stated, he was able,

* "An Inquiry into the difference of Style observable in ancient Glass Paintings, with Hints on Glass Painting, by an Amateur," p. 238, et seq.

by a very simple and moderately expensive process, to render it durable, it was certainly a most important discovery. He understood that the process was being used in the works in progress at Notre Dame, in Paris; and if successful, its adoption was more necessary in this country than in France. It was highly important that its value should be tested by the Institute most fully.

Mr. Godwin, Fellow, also urged the importance of the subject, and the propriety of referring it to a Committee; which might also consider the project of Mr. Hutchinson for the same purpose, which had been tried at Tonbridge Wells.

Mr. Jennings, Fellow, believed Mr. Hutchinson's project had not succeeded. Its object was rather to keep out damp than to preserve the stone.

Mr. C. H. Smith, Visitor, concurred in the importance of the question, and stated that there were now in London many ship loads of stone which ought never to have been imported, and which had only been brought here from mistaken feelings of economy. There were many plans for arresting decay in stone, and some of them were practicable and desirable upon a small scale; but there was great difficulty in applying them extensively.

Mr. Scott alluded to another process, consisting in the employment of an oleaginous composition, which he had some time ago suggested to the Dean and Chapter of Westminster.

Mr. Burnell, Visitor, observed that the attention of the Committee should not be limited to the different processes referred to, but they should ascertain, if possible, the *causes of decay* in stone; inasmuch as the same kind of stone was often employed in different localities with very different results.

ON THE APPLICATION OF PAINTED GLASS TO BUILDINGS IN VARIOUS STYLES OF ARCHITECTURE.

Being a Discussion held at the Royal Institute of British Architects, December 12, 1853.

The Chairman, Mr. T. H. Wyatt, V.P., invited Mr. Trotman, Visitor, to give some explanation of the drawings exhibited by him.

Mr. Trotman proceeded to describe the subjects in chronological order. The first was one of a series of four subjects relating to the history of Christ, from the Church of Rivenhall, Essex, which had been procured from Tours some years ago by the present Vicar, for the decoration of the church. These specimens dated from about the beginning of the 12th century. The whole of the ground colour was a rich bright blue; a quantity of green was intermixed with this in the figures, and great relief and brilliancy was given to the design by the introduction of characteristic lines of white. Mr. Trotman next referred to similar specimens from Canterbury Cathedral, and to four subjects from York Cathedral, the most perfect, out of seven, representing the corporeal Acts of Mercy—Giving shelter to the Houseless, Visiting the Sick, &c. Two large drawings of windows in the Church of West Wickham, Kent, representing the Virgin and Infant Saviour, and the Virgin and St. Anne, were next noticed; these being of the latter half of the 15th century. A Nativity from Great Malvern Church; one of the heraldic badges from the East end of Henry the Seventh's Chapel; the Visit of the Queen of Sheba to King Solomon, from Fairford Church, Gloucestershire; and an interesting specimen from the Hammermen's Chapel in the Cowgate, Edinburgh, representing the National Arms of Scotland ("the Scottish Lion"), were then referred to and described; and Mr. Trotman further directed attention to a series of small drawings of painted glass from the Continent, including specimens from Paris, Rouen, Brussels, Cologne, &c. Mr. Trotman expressed his concurrence in the views of Mr. Winston generally, and regretted that some false principles should have been promulgated on the subject of glass painting by Mr. Redgrave, in the Catalogue of the Contents of the Museum of Ornamental Art, that gentleman having objected to the introduction of shadows, and observed that "glass painting should consist of flat tints without shadow." On the contrary, he (Mr. Trotman) considered that if shadow were to be omitted, there must be an end of glass painting; and certainly the folds of drapery, &c., could not be better represented by outline than by shadow, especially as painted windows must be seen from a great distance. The real question was, to what extent the principle of shadow and rotundity should be carried. Some of the medallions in Canterbury Cathedral were in simple outline, whilst the East window of St. Bride's Church (the Descent from the Cross, by Muss, after Rubens) was remarkable for depth of shadow; and each of these alike failed to realize the resources of glass painting. The object to be attained was the highest degree of brilliancy consistent with a high degree of art; and he therefore could not sufficiently admire the sentiments of Mr. Winston, who had given a severe blow to the merely antiquarian view of the subject, and to the fallacy of direct imitation of Mediæval glass painting. Ward and Nixon, in their work at Westminster Abbey, were to be commended for not adhering too rigidly to the old models, although they had not succeeded in developing all the resources of the art. As a general principle, in order to insure that brilliancy which glass offered, it was necessary to treat every subject with considerable subdivision, and great attention to detail. In some modern glass painting much of the interest was lost by a neglect of accessories and details, and the modern glass at Cologne Cathedral was objectionable in this respect, as it consisted of single figures with large masses of drapery. By subdivision he meant a more complicated style of composition than was necessary in any other kind of painting. Thus, the Church of St. Vincent de Paul, at Paris, possessed some of the finest specimens of modern glass; but from the figures being too colossal, and occupying each one window, the subjects were less interesting, and less brilliancy was obtained, than a different treatment would have insured. The effect of colossal figures in

glass painting tended to diminish the apparent magnitude of the building, and was exemplified at the East end of the Chapel of Eton College, where the windows of Mr. Willement had an injurious effect. Upon the whole, he considered it would be very wrong to study the specimens exhibited with a servile regard to precedent, but rather as offering so many steps towards the attainment of a good and effective style. The human figure must be considered essential, either singly or in groups, as windows representing only foliage, &c., could not be interesting, and should rather be classed as ornamentation than art. The subjects should be on as small a scale as was consistent with distinctness, and, so long as the necessary brilliancy was not detracted from, there was no limit to the application of shadow. Useful hints might be taken from sculpture in relievo, and from such works as the bronze Gates by Ghiberti, at Florence, care being taken to render the figures important and the accessories subordinate.

The Rev. J. L. Petit, Honorary Member, concurred with Mr. Winston, whose object, it appeared, was to combine the merits of the glass of the 12th and 13th centuries, with a degree of art and beauty not then obtained; and in so doing he would not violate the principles of that era, when the artists got the best models and drew as well as they could. Servile imitation should be scrupulously avoided, and if works of art of a high character were unsuited to Gothic buildings, then the Gothic was not the style for the age. The architect should make himself independent of the painter and the sculptor; but when their aid was offered in the finest art, he should be able to exalt that art, and so to place the specimens of it that they should appear exalted even in their subordination to the architect. Thus the Grecian, the Roman and the Italian styles, admitted of the application of art in its highest character; and so the Mediæval architecture admitted the best specimens of art that could then be obtained. If, on the contrary, at the present time Gothic and the highest art were incompatible, that style ought not to be pursued. Architects should endeavour to revive, to modify, and improve it; but if they could not make it a noble style, let it be abandoned.

Mr. E. T. Parris, Visitor, drew attention to the cartoons of Raffaele as being, in his opinion, composed upon principles similar to those which should regulate glass painting. In those works every relief was gained by an opposition of colour, rather than by shadow; and, as in the best stained glass, the horizon was very high, its line being always broken by colour or form of some sort—in one instance by a house on fire, the object of introducing which could only proceed from some artistic principle. He fully agreed with the remarks of Mr. Winston. Many painted glass windows had been erected from his (Mr. Parris') designs, but he was generally trammelled by the person who had the order. He had declined the work at Westminster Abbey, executed by Mr. Nixon, for this reason.

Mr. Papworth, Fellow, observed that the discussion had been directed rather to the best styles of glass painting for Mediæval architecture, than to "the proper application of painted glass to buildings in various styles of architecture." The question to be laid before them by Mr. Winston, was whether they ought to have any stained glass at all. Stained glass either was or was not a necessity to the architect, and it would be well to settle this as a principle. In the majority of the works of modern architects the question was a difficult one. They could not all build churches and fill the windows with stained glass, or decorate old churches in the same way, their business being rather with a great variety of public and domestic buildings; and the difficulty was whether painted glass was applicable to domestic uses, and if so, what style should be adopted. The reply to this question would answer the previous enquiry—whether they were to have painted glass at all. He considered there was a great deal of merit in that kind of glass which had been largely introduced since 1800, consisting chiefly of ground glass, with arabesques and other ornaments painted upon it. Probably Mr. Winston would state whether he thought that kind of painting applicable to the wants and purposes of the present day.

Mr. Alfred Bailey observed that there was one variety of Mediæval painted glass which had not been

referred to. This was to be found in the minor towns of Central Italy, and appeared to have been executed late in the 15th century, and designed on totally different principles to any other kind. They resembled in general design the English glass of the 13th century, but instead of the colours being arranged in small lines, they were introduced in large masses, giving a broad effect of colour. Figures were introduced but sparingly, and generally small; which was remarkable, considering the perfection attained in the Fine Arts at that period. Mr. Bailey referred to specimens at Arezzo, Perugia, and Assisi. With regard to the question of the style of art suitable to painted glass, he believed that a finished pictorial composition was not suited to that material. In S. Petronio, at Bologna, two of the grandest figures designed by Michael Angelo were introduced in stained glass, with a great deal of light and shade, and produced a most unpleasant effect. Mr. Winston did not object to shadows, perspective, and even landscape back-grounds, but it required great study to know what effect a picture would have, and whether it was a fit subject to permit the passage of light. None of our best artists would like a good picture to be placed in the situation of a painted blind. Architects often neglected to consider where they should place painted windows, and a very bad effect was sometimes produced by having them at the level of the eye. A grand and broad effect of colour should be sought for rather than a result resembling patch work; and the architect should especially remember the importance of painted windows, as striking the immediate attention of the spectator on entering the building; and, consequently, if these were too much elaborated, they must detract from the effect of the building itself.

Mr. Twining, Visitor, was of opinion that stained glass should not be made to compete with oil paintings, but should be rather of an ornamental character. Painted windows being generally placed at a considerable height, were not adapted by position to receive representations of landscapes,—especially of flat scenery; and moreover architectural subjects seen in an elevated position must be represented by false perspective. The representation of groups on different panes was objectionable, because the metallic slips which formed their outlines were necessarily of the same thickness throughout.

Mr. Hesketh, Fellow, called attention to some books containing a series of original illuminations from MSS. on vellum, collected by Major Macdonald in Arabia, Syria, and Italy. The beauty of these illuminations, and the principles upon which they were designed and coloured, admirably adapted them for imitation in glass painting. In reference to paucity of subjects for stained glass, he might suggest the metaphorical subjects abounding in the Scriptures,—such, for instance, as the meeting of Righteousness and Peace; and many others, which Flaxman had mentioned as never having been treated by artists.

Mr. Talbot Bury, Fellow, regretted that a sufficient amount of talent had not hitherto been brought to bear upon glass painting. He agreed with Mr. Winston that those designs in which the light was centralized were failures, because the objects represented must be transparent or semi-transparent. One obstacle to enlisting talented artists as glass painters arose from the mania for collecting specimens of old glass of any kind, and putting them together as "ruins,"—or copying and imitating them. Again, a first-rate painter would not be fettered by a glass cutter, or by any rules or dogmas as to the style of drawing he should adopt. The advice of the artist was too often neglected, and people would not give sufficient remuneration for his work—that was the true cause of the inferiority of the art. It had become a matter of competition, and the person who gave the most glass and the most colour for the money, was employed, without regard to merit. Individuals, committees, and the clergy, were alike ignorant of the principles of the art, and were too often influenced by a mere prejudice in favour of antiquity. He wished, therefore, that Mr. Winston's paper could be extensively circulated, for the dissemination of good taste. So long as nine-tenths of the world preferred the barbarisms of antiquity to the finest works, he did not know what could be done to improve the art of glass painting. Mr. Bury referred to a drawing of the east window from Lincoln's Inn Chapel, &c., as an illustration of bad taste in modern work. He agreed with

Mr. Winston that by an artist the mullions dividing a window might be overlooked; but that was not the case with others, and when, as in some instances, a canopy or other object on the glass was completely divided by a mullion, as in a German specimen among the drawings, the effect was very bad.

Mr. Winston, Honorary Member, expressed the great pleasure and instruction he had derived from the discussion on the subject of his paper. Not being a professed artist, he had been obliged to study the subject in a desultory way, and rather by actual observation and comparison than by deep reflection. Hence, he had not given his attention to the subject of painted glass for domestic purposes. He agreed with Mr. Trotman as to the principle of subdivision, and in his objection to colossal figures. Some of the figures in ancient windows did not appear so large as they actually were, in consequence of their skilful treatment by the artist. A figure of St. Christopher, at Strasburg Cathedral, of the 12th or 13th century, was nearly fourteen feet high; but the drapery was broken in every direction by lines of different colours, and there was little or no shadow; so that the general effect to the eye was similar to that of a mass of colours, or a regular pattern. The remarks of Mr. Parris, as to the Cartoons of Raffaele, were new to him, and he quite agreed with them. Sir C. Eastlake had also pointed out the manner in which Raffaele had adapted his compositions to their execution in a material incapable of any great effect of depth. He agreed with Mr. Papworth that ornamented ground glass had much merit. It looked somewhat flimsy; but it was very pretty, and certainly better than plain glass. It might be a question how far painted glass was suited to modern domestic habits. Mr. Winston mentioned the round patterns seen in German glass, and Mr. Powell's patent for stamping glass. The weight of this latter material, however, rendered it objectionable for a window to be raised and lowered, but it was well suited to staircase windows, &c. What he had stated respecting the flat and the rotund style of glass painting should be borne in mind; and the material should not be forced beyond its capabilities. The early MSS. certainly contained valuable hints in their illuminations. Mr. Bury's remarks on the question of the cost of good windows were perfectly true; and it was impossible to deny the superiority of foreign stained glass. The specimens in the Great Exhibition of 1851 amply proved this. These were works produced under the fostering patronage of powerful individuals. It should be remembered that not only was there an objection to pay adequately for good works, but that a vast deal of money was wasted on bad works. It would be better to have one good one than fifty bad ones. The erection of one fine window in a church was sufficient for a generation, and doing more than that in an imperfect way, was only impeding what might be better done hereafter. It was the province of architects to elevate this art by impressing its importance upon their employers; and he felt sure that there would be no want of skilful designers, if proper encouragement were offered to them.

The Chairman, in proposing a vote of thanks to Mr. Winston, concurred in the necessity of architects forcing their employers in every possible case to encourage a higher style of art. He would never himself be a party to the erection of a stained glass window, unless he had a choice both of the cartoon and the artist. Their difficulties had arisen from a combination of circumstances,—of which not the least was the fact, that the whole world professed to be critics, especially in Mediæval art, and acknowledged no judgment but their own. He took occasion to refer to the new window in Mr. Hope's church, in Margaret Street, which he described as most unsatisfactory, though he had met several persons who considered it the finest of modern specimens.

Thanks were voted to Mr. Winston for his paper and further remarks, as well as to Messrs. Trotman, Bury, and others, who had exhibited the drawings on the walls, and the Meeting adjourned to January 9th, 1854.

Royal Institute of British Architects.

Communication from the Honorary Secretary of Foreign Correspondence, January 9th, 1854.

Gentlemen,

I have to announce to you various events of a chequered character, which have occurred abroad since our last meeting. You will learn with much satisfaction that the Institute of France have elected our Honorary and Corresponding Member, Herr Zanth of Stuttgard, a Corresponding Member of that distinguished body; an election equally honorable to both parties: to our professional brother, as a testimony to his distinguished merits as an architect, and to the Institute of France, as evincing the discrimination with which they recognise foreign talent. A curious incident adds interest to the event: one of our colleagues, and member of that Institute, as soon as the election was decided, dispatched a message by telegraph to Wurtemberg to announce the fact. It had of course to pass, in its course of some hundreds of miles, through several States, and to incur some delay in the delivery; it, however, reached its destination in two hours, and in two more the zealous friend at Paris had the satisfaction of knowing that the welcome message had arrived, and of receiving Herr Zanth's acknowledgments for the promptitude with which the gratifying announcement had been made to reach him.

At our first meeting of the session in November last, it was my duty to communicate to you the death of our Honorary and Corresponding Member, Monsieur Fontaine. I little expected so soon to have to inform you of other losses from among those with whom I stood at the tomb of Percier and Fontaine, when I had to express to those around me your sympathy in the loss which France had then experienced—little did I think, as the venerable and accomplished Achille Leclère stood trembling, weeping, his grey hair floating in the wind, and uttering the few words to which his grief gave vent, that he was standing himself on the verge of eternity: but he, too, has followed his brother architect. On the 26th of December last his remains were accompanied to the Cimetière du Nord, amid the regrets of his colleagues, his friends and his pupils; and eulogiums were pronounced by Messrs. Raoul Rochette, Vinet, Visconti and Isabelle.

It appears that Monsieur Leclère carried of the *Grand Prix* in 1808, at twenty-two years of age—a very unusual circumstance in the life of an architect. The programme of the competition was a large establishment of public and private baths for the capital; and the manner in which he had carried out his conception was most remarkable. During his residence at Rome the studies of the young *pensionnaire* were always well chosen, and conscientiously and well executed. His restoration of the Pantheon was the crowning point of his many researches amongst antique monuments, and placed him amongst the most distinguished architects who had given their attention to the restoration of that magnificent building of the Augustan age. M. Leclère also made an interesting collection of studies on the modern edifices of Italy. A student in the celebrated school of Percier, whose taste and learned maxims extended throughout Europe, the pupil, after his return to Paris, was attached by his worthy master to the administrative department of the Conseil des Bâtimens, in whose works he took part for thirty years; and when the celebrated Professor was unable to continue his labors in the school, he entrusted them to the direction of Monsieur Leclère. These circumstances were the chief cause which prevented M. Leclère from being engaged in the erection of more public buildings; however, he executed in France many large country houses, and in Paris some of the finest houses of modern times. One of the most remarkable monuments in the Eastern Cemetery of Paris, that of Casimir Pèrier, was designed and executed under his direction. His brilliant début as pupil,

and his subsequent works as *pensionnaire* of the Academy, were followed by M. Leclère's early entrance into the Institute, where he was called upon to take part in the works of the Professors in the School of Fine Arts, who appointed him "*Archiviste.*" Of a kind and conciliating disposition, full of love for his art, persevering in those principles which he believed to be the best, encouraging those pupils who were studious and distinguished, M. Leclère well deserves all the encomiums which accompany his memory to the tomb. M. Leclère presented to this Institute some very important tracings of the constructions of the Pantheon at Rome, next the portico, with a view to explain whether the portico formed a portion of the original design, or was a subsequent addition of a later period: they are preserved in our collection of original designs and drawings, which are now forming a very valuable series.

In the funeral cortège of Mons. Leclère, just noticed, you will perhaps have remarked the name of Visconti, as one of those who addressed the assembly at the grave of his friend; within one short week Visconti was himself cut off suddenly by an apoplectic fit, and borne to the cemetery of Père la Chaise amidst the grief of all France—and may I not add? of all Europe. Mons. Visconti was present on Thursday the 29th of December at the first meeting of the Commission for the Exhibition of 1855, at the Palais Royal, under the Prince Napoleon, and remained there from 1 to half past 3 o'clock; he then left, and went to his office at the Louvre with a friend, M. Semard; with him he had an animated conversation, and having to dine out, he asked for his carriage, but it being then only half past 4, and earlier than the time he usually quitted the works, it had not arrived, and he sent for a hackney carriage. M. Semard saw him into the carriage, and it drove off, and soon reached his residence; the coachman got down and opened the door, when he found Mons. Visconti quite dead.

He had just reached the culminating point of glory for an artist, by having had confided to him the completion of the Louvre, which had occupied the genius of French architects for two centuries. He had reaped the fruits of laborious and profound studies in the very highest departments of our art, by solving the problem, which seemed to present difficulties apparently irreconcileable and almost insurmountable; and he had commenced, and to a great extent carried into effect (to the height of 30 feet in some parts) with inconceivable rapidity, the outlines of his grand design, which united all suffrages, and promises to render the Palaces of the Louvre and Tuilleries the finest sovereign-residences in the world. At the same time it must be confessed that the conceptions of other architects, as Percier and Fontaine, and more recently, of Mons. Dusillon, had considerably assisted him in the solution.

I had from his own lips the following account of his appointment to this important work. He received very unexpectedly, about three years since, a notice from the officer of the household of the President of the Republic, to the effect that he would be received next day at the Elysée Bourbon at a certain hour; he duly attended, and was soon ushered into the Cabinet of the Chief of the State, by whom he was received most courteously. "It appears to me," said Louis Napoleon, "that the Palace of the Louvre should no longer remain in a condition which reflects disgrace on the Government, and it is desirable that employment should be provided for the working classes; I have therefore conceived the design for the completion of this palace, which I wish you to undertake." "Sir," replied Visconti, "I am gratified by so honorable a mark of your confidence, but I venture to remind you that Mons. Duban is architect of the Louvre, and it is impossible for me to interfere with a position which he fills with so much credit and ability." "True," replied the President, "but Mons. Duban is architect of the works of the Old Louvre; I wish you to undertake this appointment as architect of the works of the New Louvre, which are to be quite distinct, and to be a charge entirely separate, and not interfering with or superseding the other." "In that case," said Mons. Visconti, "I am quite at your command." The Prince then explained a scheme that he had himself conceived and roughly sketched, which he wished Visconti to draw out architecturally, and asked how much time would be required. When informed a month, he said "Well, in a month I shall expect you

to come, and you shall be admitted at once." At the end of that time, Mons. Visconti took the plans, and submitted them to the President, who highly approved of the manner in which his views had been carried out. Mons. Visconti then ventured to suggest that, in the course of study to which the plans had given rise, it had occurred to him that a much nobler and more desirable arrangement could be adopted, which he should wish to submit to his Highness' approval. The Prince immediately encouraged the architect to develop his views, and this he did in his succinct, clear and convincing manner, so as to carry the conviction of the President, who then asked him how much time he would require to prepare the necessary drawings. Six weeks. "Enough," said L. Napoleon, "and in six weeks bring me your project thoroughly considered." Accordingly, in six weeks Visconti again attended at the Elysée Bourbon; but, during the interval, the Republic had become an Empire, and the President Emperor. It was sufficient for Louis Napoleon to see the design which his architect had prepared; his ready aptitude seized all the superiority of the arrangements proposed, and he expressed himself perfectly satisfied. Taking out a paper from his breast pocket, he presented it to Visconti, saying, "Take this document; it constitutes you architect of the new works of the Louvre." In fact, it proved to be a formal document, signed by the proper authorities. The Emperor desired him to be ready to attend a council in a few days, and explain the plan, and to be prepared with general estimates as to the cost. Our architect, of course, was punctual to the appointment, and while awaiting the meeting of the council, engaged in conversation with several of the members. Being anxious to ascertain their sentiments, he asked their opinion: one thought it a very fine design; another, that it must cost a great deal of money; but none would venture to pronounce that it was a desirable and executable project. At length the council met, and the most vehement objections were taken to the idea; the principal one being, I believe, to its vast cost. At length the chief minister said, "It is the wish of the Emperor." These words at once calmed the storm, like oil poured upon the waves; not a dissentient was heard; many raised their voices in praise of the noble conception of the Emperor, and the immense talent of the architect; and the requisite millions no longer forming any obstacle, the design was approved, and ordered for execution with the necessary funds.

I do not at the moment call to mind any very large public building that Mons. Visconti has erected at Paris; but the monument of Molière in the Rue Richelieu, the fountain on the site of the old Opera Place Louvois, the noble fountain of the Place S. Sulpice with the sedent statues of the four great Doctors of the Gallican church, a fine façade at the angle of two streets in the Rue Neuve des Petits Champs, and lastly, the tomb of the Emperor Napoleon under the dome of the Invalides, attest the fertile imagination, originality, knowledge and taste of Visconti, and doubtless contributed to indicate to Louis Napoleon one capable of realising the noblest projects in his art.

In October last I experienced many marked attentions from our colleague, due doubtless to the position I hold among you as your Foreign Secretary. He received me at his house, and I must own that his reception rooms displayed refinement and elegance superior to any other private residence in Paris. The furniture was of a superb description, and full-sized chiffonnières of black ebony with glazed fronts contained most exquisite enamels of various sizes, dishes and vases of Raphael and Lucca della Robbia ware, or china of the revival; there were fine bronzes and choice pictures: in fact, one seemed to breathe an atmosphere of art, evidencing the host a man of refined taste, and one who possessed a perfect discriminating relish for all the arts.

He was heir to a great European name, one of a family distinguished for archæological learning, and has nobly maintained the reputation of his ancestors. His personal presence did not seem to indicate the noble qualities within him; but his exalted genius, his simple unaffected manners, his cordial address, his loyal and generous sentiments were the confidence, the esteem and admiration of all who were admitted to his friendship. I need hardly say how highly he valued the gratifying compliment paid him by this

Institute in electing him an Honorary Member. He entrusted me for presentation with a copy of the work shewing his design for the completion of the Louvre, inscribed with his own hand, and, at my request, has sent you full-sized drawings of certain iron girders for the floors, one of 70 ft. span, which he purposed employing. At some future evening, with your permission, I may perhaps give a history of the Louvre and Tuilleries, note the various projects for their union, describe that of our lamented colleague, and explain some points of ingenious construction in the floors.

Last Wednesday, only five days ago, his remains were deposited in Père la Chaise, followed by one of the carriages of the Emperor, and attended by many Ministers of State and noble functionaries, the leading men in science, literature, and the fine arts; his pall borne by the most distinguished men in France, and accompanied by the tears and regrets of several hundred workmen, who felt that they had lost indeed a noble leader. The long line of streets, which led to the cemetery, abounded with testimonies of respect to the memory of this great man. And a Minister of State, the perpetual Secretary of the Academy of Fine Arts, our colleague, Mons. Caristie, Mons. Rohault de Fleury, and Mons. le Baron Paul de Richemont successively addressed the thousands assembled, as did also our Honorary and Corresponding Member, Mons. Hittorff, from whose touching discourse I borrow a few sentences, which seem penetrated with a due appreciation of the character of his colleague and friend.

" The loss " said Mons. Hittorff " of an artist, who united the highest faculties of the mind to the no less noble qualities of the heart, is afflicting to those who were privileged to possess the opportunities of appreciating in him those high natural gifts. But when, as now, this artist is carried off in the midst of the most important works, at the moment when he might naturally look forward, as we all might, to their happy completion and glorious success, this loss is no longer a mere family bereavement, it is a public calamity. Certainly in the immense and grandiose work, which fell to the lot of Visconti, it required, in addition to the conception of the architect, a rare combination of circumstances to carry up, in less than two years, that which had occupied nearly half a century under the greatest of our kings; it required still more to know how, as did our friend, by incessant activity, by a rapid coup d'œil, by a discernment as prompt as just, to render available all those precious elements, and to organize an army, as it were, of able and intelligent assistants and artificers to carry out the work.

" The head of the State was doubtless glad to connect his name with the completion of the finest palace in the world, and perhaps, still more to recall by such a work, minds which had too long been led astray; nor did the architect peril his fair fame in this surprising rapidity of execution, which astonished all Paris, and excited the wonder of those foreigners who flocked hither. Mons. Visconti bestowed the utmost care upon the soundness of the construction, as upon the exquisite beauty of the design. These incessant occupations and flattering combination of circumstances did not at all alter the natural character of our friend. Although naturally aware of his own capacity, surrounded by numerous gifts of fortune, raised to the enviable position of Architect to his Emperor, Member of the Institute of France, President of the Central Society of Architects, nothing altered the constant amenity of his character, he was still the same unaffected modest man, always ready to oblige, and ever disposed to recognise the merit of others."

To such an eulogium it is unnecessary for me to add one word; but, in conclusion, I beg to notice an inadvertant expression which escaped M. Rohault de Fleury in his address—it is contained in these words, " *it has been said with just reason that the loss of Monsieur Visconti is irreparable.*" To his family and friends such a bereavement is irreparable: but you and I, gentlemen, must feel, that however great this loss may be to architecture, it cannot be irreparable to France, when she possesses so many men of such distinguished talents to uphold the high rank which she has attained in the commonwealth of the arts.

It is my melancholy duty to announce also the death of Mons. Gau, also our Honorary and Corresponding Member, author of the noble work on Nubia, and architect of the new Gothic church, S. Clotilde,

in the Faubourg S. Germain. M. Gau had also erected a very extensive prison at Paris, and had executed various other works of considerable importance. He was a native of Cologne, but had passed his professional life at Paris.

These few notes, hastily put together, may prove to our professional brethren abroad, that we are watching their works, admiring their talents, sharing their sympathies. Let Architecture, at all events, produce harmony and good feeling among all her sons, in whatever country they may be.

The following is an extract from Mons. Hittorff's address, on the 9th of January instant, at the tomb of his countryman and brother architect:—

" M. Gau naquit avec de rares dispositions pour l'architecture, et après avoir suivi pendant plusieurs années notre école des Beaux-Arts il partit pour Rome en 1817. Il y fit de fortes études, releva et publia les plans du Vatican et mesura les plus intéressans monumens antiques et modernes de l'Italie. Préparé par le célèbre Niebuhr à nne exploratione de l'Egypte, il exécuta avec un force de caractère inouie, la périlleuse et difficile entreprise de complêter *a lui seul*, par le recueil des monumens elevés entre la première et la seconde cataracte, l'immortel ouvrage de l'expédition Française sur les bords du Nil. Tout le monde reudit justice à ce beau travail qui porte l'empreinte de la conscience et du talent et qui fixa les opinions des savans sur l'origine et le développement de l'architecture Egyptienne dans la Nubie. N'eût-il publié que cette œuvre, elle suffirait à la gloire de son nom. Mais M. Gau y ajouta un nouveau lustre en complétant et en achevant, avec non moins le talent, le remarquable ouvrage de Mazois snr les Ruines de Pompée, et en se livrant avec un succès mérité à la pratique de son art. Successivement architecte des travaux d'art d'un de nos premiers chemins de fer, de l'administration des hospices, de la Banque de France, de la ville de Paris, partout l'habile artist sut faire apprécier un grand savoir, mûri par de fortes études, et réuni à une rigide intégrité. Qualités éminentes qui lui valurent de nomoreux et importans travaux particuliers. Toutefois, la construction la plus importante qui occupa M. Gau, pendant les dernières vingt années de sa vie, ce fut la conception et l'exécution de la nouvelle église de Sainte Clotilde. . . . . Hélas! cette basilique dont l'achèvement dut être le rêve de bonheur de la fin de sa vie, qu'il vit abritée de sa belle couverture en fer, dont les grosses constructions furent achevées sous ses yeux, une cruelle maladie priva son auteur d'y avoir pu mettre les pieds depuis près de deux années! Quelle ne dut pas être la douleur du pauvre artiste lorsque, sans espoir de retrouver la faculté de ses membres paralysés, la pensée de ne jamais contempler accomplie sa belle œuvre, vint l'accabler de sa poignante réalité! "

DESCRIPTION OF THE FRENCH METHOD OF CONSTRUCTING IRON FLOORS.

Read at the Ordinary General Meeting of the Royal Institute of British Architects, January 9th, 1854.

By H. H. Burnell, Associate.

In describing the system of the "Planchers en fer," or Wrought Iron Floors, it is not my intention to enter into a detailed account of the various experiments made before the systems now so generally used in Paris were brought to their present state of perfection,—to occupy your time with calculations of the resisting powers of rolled iron, or discuss the suitability of the forms adopted; but avoiding all that might tend to embarrass the question, I propose to confine myself to a succinct and simple description of the systems now most frequently executed, and to furnish such practical information as I have obtained by visiting the works where they are employed, and hearing the opinions of the architects conducting them.

It would seem that, for some years past, floors composed of rolled iron joists have been occasionally executed in Paris; in most cases, the joists were flat and without flanges: such constructions were known as the Système Vaux. The systems to which I am about to draw attention are little more than an improvement in the form of the joist, and may be said to have come into general use at the commencement of the extensive alterations in the Rue de Rivoli, in the spring of the year 1852.

In the various works treating on the subject several systems are described, but upon visiting the Parisian buildings now in progress, we perceive but two: one purporting to be the system of Mons. Thuasne, and the other appearing to be that of any one who may get an order to execute it. From the observations made by parties conversant with the matter, I am induced to believe that the different systems are no longer recognised in general practice, and that the architect or builder combines at pleasure the advantages of all.

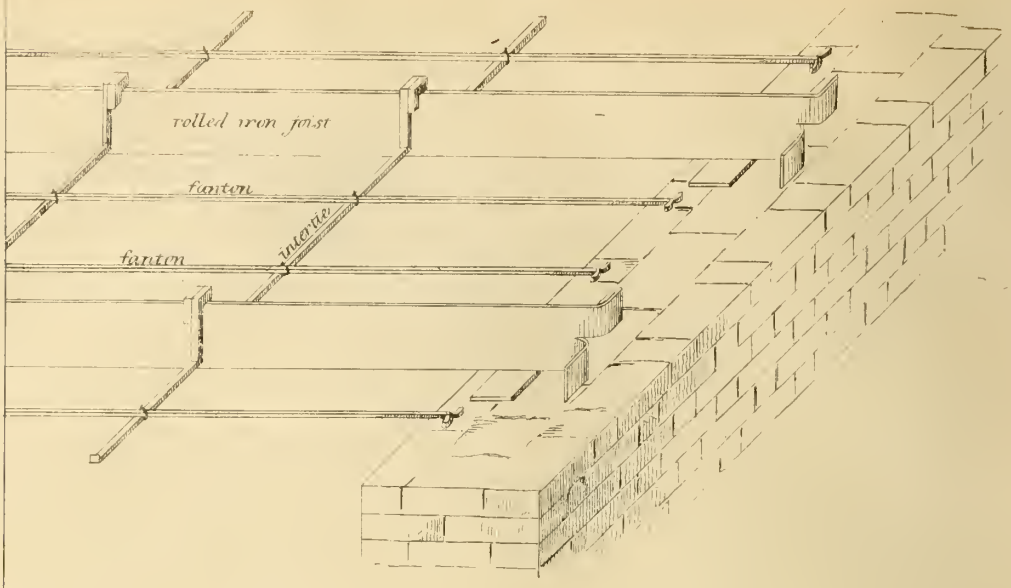
The "Système Thuasne" may be described as being composed of joists of iron, rolled in the form of the double T, and slightly arched in the proportion of 0.005 mètre in the mètre, or of 1 in 200. They are placed at the distance of 1.00 mètre (or 3 ft. $3\frac{1}{3}$ in.) from centre to centre, and are united by interties, formed of flat iron bars, fixed at the same distance of one metre apart. These interties rest on the lower flanges of the joists, and are let into wrought iron bands fixed round them; a small pin is then driven through the hole at the extremity of the intertie, between the joist and the band, and the transverse tie is formed.

The fantons are light iron rods, fron $\frac{3}{8}$ to $\frac{1}{2}$ in. square, of the same length as the joists, and parallel with them; they are laid on the interties, and bound to them with copper wire, and may be said to take the place of the ceiling laths. Some of the joists and interties next the walls have their ends so formed as to make them act as ties; thus the ends of the system being firmly built into the walls, the sides of the house are effectually united. The iron-work is usually painted, and allowed to dry thoroughly, before it is brought to the place of construction.

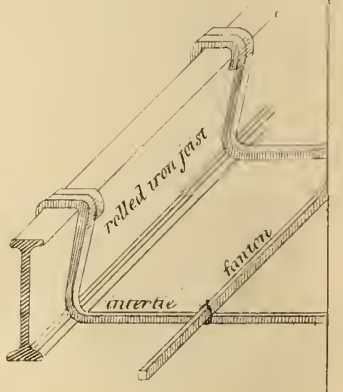
The above-described net-work of iron being completed, the next process is the plastering or grouting. This process differs so materially from the English mode of forming a ceiling, and is so important a part of the scheme, that it requires to be understood before the success of the whole can be comprehended. It is done thus: a board or flat centering is placed under the part intended to be filled in; a grouting composed of the coarsest quality of plaster is then poured in upon it, and running in between the lower portions of the iron-work, it stops against the board beneath, and forms the ceiling of the room below, which one coat of fine plaster serves to finish. The plastering thus applied is from $2\frac{1}{2}$ to 3 inches thick, and sets in about half an hour; it shortly becomes as hard as stone, and assists much to stiffen the floor.

The second system referred to differs in some degree from the first, the joists being placed nearer together, perhaps from 2 ft. 4 in. to 3 ft. apart. The interties are formed of iron bars, from $\frac{5}{8}$ to $\frac{1}{2}$ in. square, bent at the ends so as to clip the upper flange of the joist, and again crooked downwards to rest on the lower one; the elbow so made pressing against the side of the joist, a strut and tie is at once formed

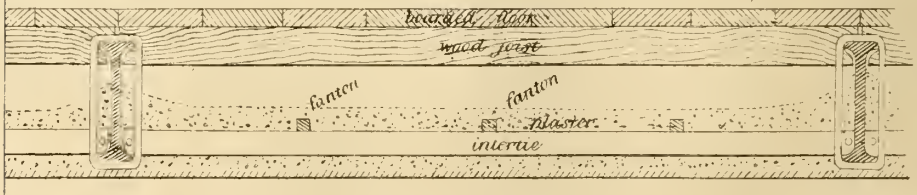
SYSTEM VAUX.

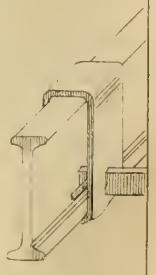


SYSTEM IN GENERAL USE



SYSTEM THUASNE





Scale 1/10 full size

Vincent Brooke Lith King St Covent Garden

FRENCH METHOD OF CONSTRUCTING IRON FLOORS. (page 36)

between the joists. Interties upon this principle are of course made as nearly as possible of the same size, and when placed between the joists, a blow with the hammer is sufficient to fix them in their position, and make them touch at the required points. They are placed about 3 ft. apart, and as nearly as may be in a direct line, so that one may resist the action of the other. The fantons or light iron rods lying parallel with the joists are laid on the interties, and the grouting performed as in the former method. The floors of the New Louvre are made upon this principle, and filled in with pottery.

It need scarcely be remarked of these rolled iron joists, that they may be made of any intermediate thickness between the stoutest and lightest of the patterns given, the depth of course remaining the same. This offers some advantages, particularly in France, where iron is dear, and the apartments divided into rooms of very different dimensions; as, in many cases, it may be desirable that the floor of the smaller room should be of the same depth as that of the larger one; but the span being less, the lighter description of joist would suffice, the internal walls being assumed to have the necessary strength to take the bearing.

As I have elsewhere observed, the grouting is always more or less of plaster, but in many cases the space between the joists is filled with pottery, that is to say, small cylinders of baked earth, about $7\frac{1}{2}$ in. high and 4 in. in diameter, having the ends closed, and somewhat resembling flower pots; these are bedded in a layer of plaster, poured in between the lower portions of the iron-work, and then receive a grouting to fill in the interstices. Perforated bricks, and pipes like those used to form land drains, are manufactured for the purpose, but are rarely used. Where a wooden floor is required (which is frequently the case) it is nailed to small joists notched in between the iron joists; sometimes, however, where economy of space is less an object, the wood joists are laid across the top of the iron work.

With regard to the relative merits of the two systems, little need be said: that of M. Thuasne binds the joists more effectually at the bottom, where they are best calculated to resist the expansion of the plaster, and it may also be accompanied with some trifling economy of iron, but notwithstanding this, it has the character of being on the whole the dearer, and on this account the other method is more generally adopted. Both offer advantages on the score of being easily fixed, and when executed with common intelligence, answer well, producing a light fire-proof floor in two-thirds of the space of the ordinary wooden construction. It will be seen that floors made upon either of these principles are as incombustible and sound-proof as most others professing to offer the same advantages. It is clear that violent heat, if long continued, would calcine the plaster and ultimately bend the joists; but even in this case, were pottery of any kind judiciously employed, it would offer a serious opposition to the flames, and would be infinitely less dangerous to those in or near the building than cast iron girders or joists with heavy masses depending upon them. I have here, however, alluded to an extreme case, as it is highly improbable that an extensive conflagration should take place where the floors and staircase are of incombustible materials.

It is with some misgiving that I speak concerning the cost, feeling that it is unlikely that a common calculation made from the French tarifs should be found a correct guide to the expense in England, as so much depends on the skill and enterprize of the parties undertaking the manufacture, the effect of competition, and the demand for the material. Perhaps for present purposes it may suffice to consider the probable prices in England to be the same as those of Paris, for it should be remembered that though we have iron in greater abundance, the wages of English exceed those of French workmen. The want of a material like the French plaster will next be felt. I am not aware that we have anything that effectually takes its place at a moderate expense. The price of French plaster in London is 32s. or 33s. per ton, about 30 per cent. dearer than in Paris; but I believe I am correct in saying that this plaster, when fresh, may be mixed with an equal quantity of sand, cinders, or ground brick, and answer the purpose in question. The cost of grouting in England must therefore be considered as double that of Paris.

The accompanying table is translated from a tarif of prices circulated by Mons. Thuasne last year; it also gives the weights and depths of the floors for the various spans.

PARIS PRICES:

Bearings.				Depth of Joist.	Depth of Floor complete.	Weight per Square.	Iron Work, per Square.			Including Grouting, (12 Shillings) per Square.		
FT.	IN.	FT.	IN.	INCHES.	INCHES.	lbs.	£.	s.	d.	£.	s.	d.
From 10	0	to 11	6	4	$7\frac{1}{8}$	370	2	19	5	3	11	5
11	6	— 13	0	$4\frac{3}{4}$	$7\frac{7}{8}$	420	3	6	5	3	18	5
13	0	— 16	6	$5\frac{1}{2}$	$8\frac{5}{8}$	465	3	14	4	4	6	4
16	6	— 20	0	$6\frac{1}{4}$	$9\frac{1}{2}$	510	4	1	9	4	13	9
20	0	— 23	0	$7\frac{1}{8}$	$10\frac{1}{4}$	605	4	17	6	5	9	6
23	0	— 26	0	$8\frac{5}{8}$	$11\frac{3}{4}$	700	5	12	4	6	4	4

I regret that I am not in a position to furnish more ample information on this head, and that I am unable to produce accounts of some experiments which might convey an idea of the resisting powers of the floors when complete, though I know that these experiments have been made; but, perhaps, the general adoption of one or other of the methods may be received as the best guarantee of their results being satisfactory.

In connexion with the subject of the general use of iron in France, much might be said on the French manner of constructing wrought iron girders, but as the most remarkable of these are to be found in the buildings of the new Louvre; and as we have just heard that all matters connected with that important building will be treated at a future meeting by our Honorary Secretary for Foreign Correspondence, I shall abstain from offering any remarks on the subject.

In conclusion, I would add that I have been induced to offer the foregoing remarks, because I conceive that an invention that is well received in a city so important as Paris, must be practically interesting to us, particularly if in our own country the advantage of that invention be partially wanting; it is true that our mode of building and inhabiting our houses differs generally from that of the French capital, where they are usually let in apartments or flats, but in many instances the same arrangements occur here, and in such cases, at least, we might avail ourselves of the experience of our talented neighbours. Many prejudices and conflicting interests must be overcome before any invention can be generally adopted; those of the Parisian building world seemed to have yielded readily to the desire to improve, and the opportunities offered to the development of a new method by the extensive character of their alterations; and though the improvements in our own metropolis proceed with less vigour, we may endeavour to evince as little prejudice as our neighbours in our enquiry into the merits of that principle, which constructively has done its part to invest their newly-erected buildings with stability and refinement worthy of the age.

The CHAIRMAN, Mr. G. GODWIN, Fellow, observed that the questions of weight and expence were among the most important in reference to the construction of iron floors; and it would be desirable to compare the method described by Mr. Burnell with similar plans which had been adopted in England. Mr. Hosking in his book on "Building in Towns," had described a method of flooring used in Paris, and some floors upon a similar principle had, he believed, been constructed at Messrs. Clowes's printing office, and had been found to answer exceedingly well.

Mr. FOWLER, Fellow, inquired what was the effect of weights on the floors described in reference to elasticity. Although doubtless strong, the joists were apparently slight; and he wished to know whether any particular deflection might take place, in the case of persons dancing on such floors.

Mr. BURNELL stated that the Rèvue Generale de l'Architecture gave the following experiment made

upon a floor 16 ft. span (systeme Vaux) the joists being $5\frac{1}{4}$ in. deep, $\frac{3}{8}$ in. thick, and cambered 2 in. in the 16 ft. Upon the grouting being filled in the camber was reduced to $1\frac{3}{4}$ in.; upon the floor being loaded with 1,000 lb. per yard super. it was reduced to $1\frac{3}{16}$ in., and after forty-eight hours pressure again decreased to 1 in., the deflection from the load being $\frac{3}{4}$ in.; the weight being removed, the floor resumed a camber of $1\frac{9}{16}$, having lost $\frac{3}{16}$ in the experiment. When filled in with pottery, these floors were lighter, but the filling in with solid plaster formed the whole, in his opinion, into a stronger and more solid mass.

Mr. G. R. Burnell, C.E. referred to a paper read by himself at the Institute in 1849, in which he had alluded to Vaux's system. Since that time several works had been published on the subject,—the most recent and the best being one by General Morin, who in the fourth volume of his "Cours de Construction" gave an elaborate set of experiments on the resistance of these floors, and the formula on which their thickness and general dimensions might be calculated. From these experiments it appeared that a floor of 26 ft. span shewed a deflection of seven centimetres, with a weight of 70 lb. on the square foot, in addition to the weight of the floor itself. It appeared to him (Mr. G. R. Burnell) that one of the great objections to the modern French system of filling in with plaster, was not so much the weight as the expansive action of the plaster. In practice the effect of this was to bring the floor down nearly half the amount of deflection, produced by the extreme load which the floor would bear. The use of pottery was therefore preferable, and it would be especially so in this country, where plaster of Paris was comparatively expensive. The conflagrations which had lately occurred in the city rendered it important to devise some incombustible flooring; and it was to be much regretted that in England insurance from fire was a tenant's tax, instead of being a landlord's tax, as in France, because there was no inducement to builders and landlords in this country to construct fire-proof houses.

Mr. Donaldson, Hon. Sec., observed that the rent was regulated in each case with reference to this fact, and the Chairman considered that the prevalence of short leases, instead of freeholds, might equally explain it.

Mr. Papworth, Fellow, referred to a house in Hinde Street, Manchester Square, built by Dr. Gillies, the Scottish historian, the roof of which was made of cast iron bars, little more than $4\frac{1}{3}$ inches deep, with a sufficient flange, and filled in with flower pots, precisely as in the French method, but cambered so as to form a vault. This had always stood exceedingly well until the walls began to settle: there was then a fracture which had caused considerable trouble; but that had been remedied, and the roof still stood very well indeed. With respect to the expansion of the plaster, mentioned by Mr. G. R. Burnell, he could not understand why it should press downwards, when there was no abutment above to prevent it expanding in an upward direction.

Mr. Fowler observed that it had an abutment above; being turned up against the joist, in a form equivalent to a curve; and, therefore, if expansion did take place, it must press downwards.

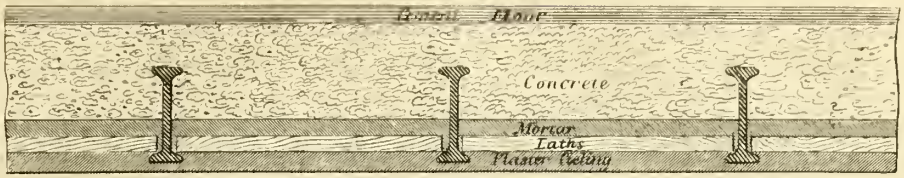
Mr. Piper, Visitor, stated that the plaster would expand in all directions. The floor at Messrs. Clowes's warehouse, referred to by the Chairman, was of the ordinary construction, with timber joists; but a plaster of Paris ceiling was attached to it, or a sort of flat centering was fixed and secured below the joists, and the plaster was filled in from above the laths; the laths being of oak, and stronger than usual, both in material and scantling, and placed at a wider interval. The plaster therefore passed through and formed the ceiling below, and a sort of pugging above; it consisted of two parts of sand to one of plaster. The floor was constructed of three courses of plain tiles, in order to make it a perfectly fire-proof and air-proof chamber, used as a drying room; no bad effects had arisen from the expansion of the plaster. With reference to the use of cast iron in floors, he had had great experience in those constructed on Fox and Barrett's principle; and it had always occurred to him that cast iron was an unsound material to be subjected to a permanent set, and to be strained as a floor was liable to be; and therefore the introduction of rolled iron joists, which were produced so successfully at the Butterley Works, was a great advantage. Six floors had been constructed with cast iron joists in the Albert Buildings, Spitalfields; and at the top of

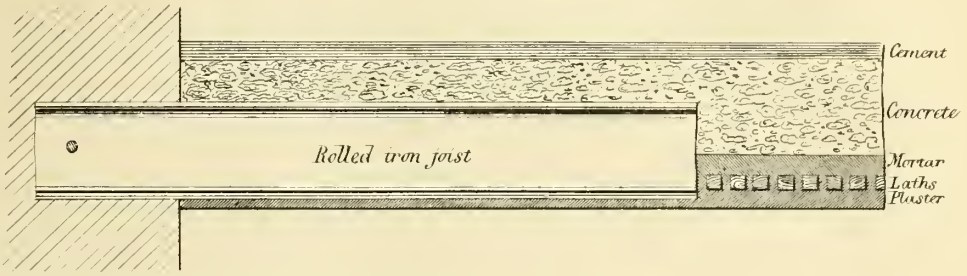
the building a defective joist broke, and fell down vertically, striking out one joist in every floor as it fell, without disturbing the rest—an illustration of the extreme brittleness of the material. Regarding the concrete as an addition to the weight, without being any addition to the strength, or having any natural cohesion or connexion with the iron, he had not been prepared to expect a very firm floor as the result of the combination, in a span of eighteen to twenty feet, in a coach manufactory in Regent Street; but on the contrary, he was surprised to find that, when the mass became set, it was rigid to an extraordinary extent, forming a kind of uniform landing, in which there was a good brotherhood between the concrete and the iron, the whole forming a trustworthy mass. With regard to the cost, his experience had shewn him that in Messrs. Fox and Barrett's construction it was equal to that of an ordinary floor, with the addition of the price of the floor boards; but the present state of the iron market would somewhat interfere with that calculation. From the actual rigidity to which he had referred, he was disposed to think the French floors described would have a great amount of strength. Alluding generally to the facilities for the spread of fire in houses, by means of skirtings, staircases, quarter partitions and roofs, as at present constructed, he illustrated the power of an ordinary plaster ceiling to resist the action of fire, by referring to a severe fire on his own premises, which began in the shop, and spreading upwards by the staircase ignited the roof, and then burnt downwards. The first floor was however left entirely perfect, and the second nearly so; the only obstacle to the fire reaching them being the plaster ceiling of the ground floor, where the fire commenced.

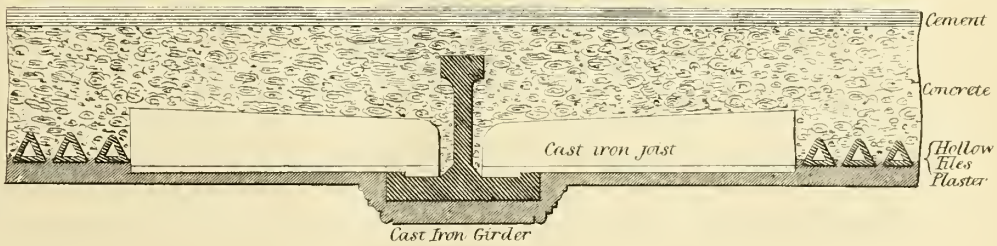
Mr. Barrett, Visitor, said that, from the remarks made this evening, he was more convinced than ever that the use of iron in the construction of floors was only a question of time. With regard to these French floors, their liability to deflection was a radical defect, as no finished floor ought to be liable to the slightest deflection or want of rigidity. The system described could moreover prevail only where plaster was abundant — as in Derbyshire, Leicestershire, Nottinghamshire. Objections were also raised to plaster on the ground of its imparting a disagreeable smell, and of its tendency to swell. He had adopted rolled iron in his own method in consequence of the prejudice against cast iron joists, and he proceeded upon this safe principle: that, taking the concrete as so much dead weight, his joists were so proportioned that that dead weight, together with the extreme load which could subsequently come upon the floor, should not exceed the elastic limit of the iron. He used rolled iron joists for spaces not exceeding 24 feet. On reference to the table of weights used in Paris, he found that the French floors had not more than half the strength of his own; thus, with a bearing of from 16 feet 6 to 20 feet, the French used a weight of iron of 510 lbs. per square, whereas he should use 8 cwt., in addition to the difference in the weight of the grouting; and therefore, if the French floors were safe with 5 cwt. of iron, his floors must be more than safe with 8 cwt.; and the cost of the latter, in joists only 18 inches to 2 feet apart, as compared with a timber floor, was about 7 to 10 per cent. additional. The thickness of concrete, on his plan, in a floor of 20 feet span, would be 7 inches from the flange of the joint, the whole substance being 12 inches thick, including 2 inches for the floor itself; and as a question of expense, it would be very easy to reduce the strength of the iron (and with perfect safety), so as to bring down the cost to that of an ordinary timber pugged floor.

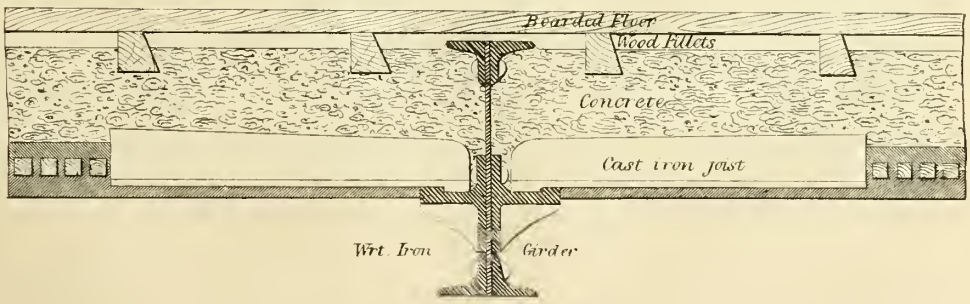
The Chairman, observing that it was impossible to overrate the importance of the subject, suggested an adjournment of the discussion, in order to elicit the careful and deliberate opinions of the members, rather than their hasty and unconsidered observations.

Mr. C. H. Smith, Visitor, stated, for the consideration of the Members, the fact that no material could be more destructive to iron, especially wrought iron, than plaster of Paris. The girders might be coated with some material to protect them, but in moving them about it was liable to be chipped off; and if the smallest pinhole were exposed to the plaster of Paris, the iron would be corroded. On the contrary, lime tended to preserve iron; and therefore a coating of $2\frac{1}{2}$ inches of ordinary mortar next to the girders, before using the plaster of Paris, might be desirable. The Meeting then adjourned.









Scale One Inch to a Foot.

Vincent Brooks Lith. King's Street Garden

MESSRS FOX AND BARRETT'S FIRE-PROOF FLOORS. *(page 41.)*

ON THE FRENCH METHOD OF CONSTRUCTING IRON FLOORS.

Being a Discussion (in continuation of that which took place at the previous Meeting) held at the Ordinary General Meeting of the Royal Institute of British Architects, January 23rd, 1854.

Mr. Barrett, Assoc: Inst: C.E., requested permission to read a Paper containing some further explanation of the system of fire-proof construction with which he was connected, and which was known as "Fox and Barrett's patent."

The objects accomplished by this system, whether applied to Public Buildings, Dwelling Houses, Warehouses, Mills, or other structures, are as follows:—

To make each floor, as well as the roof of the building, fire-proof, so that fire can neither be communicated from one story to another, nor be introduced into the building by burning away the roof:—

To avoid all lateral thrust, or weakening effect, upon the walls; and to distribute the weight over them, instead of concentrating it on certain points:—

To secure the building from the attacks of dry-rot:—

To give increased solidity, firmness, and durability to the structure:—

To render the floors practically sound-proof, when finished with a boarded surface:—

And to combine these advantages with great simplicity and economy of construction, and a much less thickness of floor than is usually required.

These objects are accomplished by forming the floors of the buildings of materials as imperishable as the walls themselves, the leading features of the system being, the substitution of girders and joists, either of wrought or cast iron, for those of timber, and the employment of layers of incombustible materials, supported by, and consolidated with the joists; the whole, when combined, forming a solid fire-proof foundation, adapted to receive a finished surface, either of cement, asphalte, tile, slate, stone, or other material; or upon which foundation the ordinary boarded surface, upon light sleepers, or bevilled fillets, may be laid down.

The principle of construction, as applied in its most simple form, is shown in drawing No. 1.* The joists are fixed as the building proceeds, the ends being firmly built into the walls; and the floor is afterwards formed by light strips of wood, being first laid across from joist to joist, bearing on the bottom flange, and having narrow spaces between them. Upon these is spread a layer of coarse mortar, which is pressed down between the strips, so as to form, with them, a rough and uneven surface for the pricking-up coat of the ceiling; the subsequent application of which thoroughly imbeds the strips in mortar. A layer of concrete is then applied, of the requisite thickness to ensure the necessary rigidity in the floors. This thickness is determined by the nature of the building, the width of bearing, and the required degree of strength. The ceiling is applied of such a thickness as to perfectly imbed the flanges of the joists, and thus protect them from the action of fire from below. A fire-proof foundation is thus formed, which, when thoroughly consolidated by the perfect setting of the concrete, is of great strength and rigidity; while the pressure upon the walls is *strictly vertical.* The finished surface of the floor is applied when the concrete is set and dry.

The joists are made of a form combining strength, lightness, and economy; their section depends upon the nature and uses of the building to which they are to be applied, and in all cases they are proved, before

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* The drawings referred to were exhibited at the Meeting, but cannot be published with the present Report.

they are fixed, to an extent more than equal to the greatest load that can ever be brought upon them, care being taken that this proof is within one-third of the breaking weight in the use of cast iron, and within the elastic limit of the material in the use of wrought iron. This precaution may perhaps be considered unnecessary with the latter material, more especially as the mode of construction is one which, in effect, ties the whole of the ironwork together. It is, however, more satisfactory to prove the joists, and it is done with a lever at the most trifling cost.

The strips, which answer the double purpose of a foundation for the concrete, and a key for the ceiling, may be made of any non-combustible material instead of wood; but it will be seen that these strips are so placed that their ignition is impossible, as they are completely imbedded in the mortar, and have a superincumbent mass of concrete, which prevents the establishment of any current of air, and renders them practically proof against fire. This has been proved on several occasions. Amongst other materials that can be substituted for these wood strips, small draining pipes may be mentioned, and if made of a triangular form, they give an excellent key for the ceiling.

The concrete is formed of the materials most readily obtained in the locality of the building, such as fine gravel or ballast, burnt clay, or broken brick, mixed with a proper proportion of good stone lime, the whole being laid on moist and well trodden in.

For the finished surface of floor, besides the ordinary flooring boards, cements of different kinds, such as Portland, Keene's, and Parian, may be used. Asphalte, metallic lava, slates, and tiles, in cement, have also been employed as a finished surface, both for floors and roofs.

In applying this system to dwelling houses and similar buildings, the joists are first tested singly to bear weights equal to from 120 to 150 lbs. per square foot of floor; that test being in the case of the employment of cast iron, one-third of the breaking weight, and in the case of wrought or rolled iron, the elastic limit of the metal. For buildings of a different character, and requiring stronger floors, the strength and the test are increased so as to meet the requirements of the structure. The joists are then fixed on the walls, and when built upon, they form a series of ties which greatly strengthen the building. A considerable accession of strength is given to the joists by their ends being thus firmly fixed in the walls, and every successive step in the process of construction tends both to develope additional strength, and also to protect the joists from the effect of impact or concussion. The strips or pipes are the groundwork of a continuous strut, which is completed by the subsequent application of the mortar and concrete, the latter completely imbedding the whole of the ironwork, which is pressed equally on both sides, and the concrete well trodden under the upper flanges of the joists. Thus it will be seen that the force of compression acts upon the joists only through the medium of the concrete. What the actual addition is to the original strength of the joists, by in the first place firmly fixing the ends, and then by the perfect union and combination obtained in the process of construction, has not been ascertained; but an idea of the enormous weight that would be required to break down a floor may be thus obtained:—Supposing the room to be 18 feet square, thus containing 324 square feet in area; the joists, having an original working strength of 120 to 150 lbs. per foot, the *average ultimate* strength is 405 lbs. per foot, and if it is assumed that an increase of 25 per cent. only, is obtained by the fixing, and the consolidation of the entire mass, the breaking weight is 500 lbs. per square foot, which, multiplied by the number of feet, 324, gives 1446 *cwt.*, or upwards of 72 *tons*, as the load required to break down the floor of a room 18 feet square; and this it should be remembered is not a floor in which extra strength is provided, but merely the room of an ordinary dwelling house, which, if packed with 200 people, or as full as the "Black Hole" at Calcutta, would only be loaded with 15 *tons*, or about one-fifth of the breaking weight of the floor. In assuming 25 per cent. as the gain in strength, a low estimate is taken, for an increase of twice this, or 50 per cent. is commonly reckoned as due to the firmly fixing of a beam alone; while the great principle of this system is

the gradual developement of strength and firmness; the effect of the load being transferred, through the medium of the concrete, to the walls, or other vertical supports; the entire floor becoming in effect, *one large beam with iron ribs*. This calculation has reference to the use of joists of cast iron; with joists of wrought or rolled iron, the ultimate strength would be considerably greater.

There is of course a limit to which single joists can be carried on this system, but as rooms 24 feet in width have been constructed with them, and without the use of main girders, it is very rarely that the latter are required for dwelling houses and buildings of the same class. When, however, the span much exceeds 20 feet, the adoption of girders, with minor joists bearing upon their flanges, is the most economical method. In this way floors of 60 feet span have been construeted, the girders having an intermediate bearing on columns placed 20 feet apart. Floors of 30, 36, and 42 feet span have also been construeted with girders and joists, without the aid of columns.

It may be said, therefore, that there is scarcely a limit to the application of the system as regards the space to be covered, while there is probably no kind of building to which it is not capable of being adapted. Besides public buildings of different kinds, such as hospitals, lunatic asylums, and workhouses; buildings for records, railway offices, banks, hotels, exhibition rooms, baths and wash-houses, training institutions and schools, &c., the system has been extensively adopted in private buildings, such as mansions and dwelling houses, offices and chambers, and dwellings for the working classes. It has also been employed in the construction of warehouses and mills.

This system of construction is not therefore to be regarded as a mere theory, but as one which has been very extensively applied, and has moreover stood the test of an experience of twenty years: I mention this first to disclaim all merit whatever in having originated it. It is to a member of the medical profession, recently deceased, Dr. Henry Hawes Fox, that we owe the introduction of this principle of construction. That gentleman erected in the years 1833-34 an extensive private lunatic asylum in Gloucestershire, and built it entirely upon this principle, and ten years afterwards, in the year 1844, at the urgent solicitation of his friends, and as the only means of bringing a valuable invention, which had on several occasions saved the building from destruction by fire, into general use, he was induced to patent it. My own connexion with it dates from the year 1848, since which period it has, as I have said, been applied successfully to almost every description of building. Another reason for my mentioning the early employment of this mode of construction, and the date and object of its being patented in England, is, that it has struck me that some persons may possibly imagine that the principle may have been borrowed from the French system, described in Mr. Burnell's paper. Nothing could be more erroneous than such a supposition; a comparison of dates indeed at once sets this question at rest, the patent having been taken out in 1844, ten years after its successful employment by the patentee, while, as I gather from Mr. Burnell's paper, the employment of the French system is comparatively of recent date.

In 1850 I visited Paris myself, with letters of introduction to various architects, only one of whom referred to the use of iron there. He told me that a building was then in course of erection, and recommended me to see it, which I did: it was the Hospice de la Republique, near the Northern Railway Station. The floors were formed by means of girders of wrought iron, consisting of two rectangular bars, the lower one straight, and the upper one arched or curved, both placed on edge, and the two occasionally tied together by vertical straps. These were placed about 5 ft. apart; cross bars 4 ft. apart were carried at right angles with the girders, and three smaller flat bars on edge ran between each girder: spaces of about 4 ft. $\times$ 15 in. were thus formed, and these spaces were filled in with pottery, slightly wedge-shaped, imbedded in plaster; dwarf walls were built on the top of the pots to receive timber joists, upon which the floor boards were laid. The whole appeared to be a very expensive mode of construction, occupying a depth of about 18 in. for a span of $3\frac{1}{2}$ mètres or 11 ft. 6 in. This was the only instance I heard of, at a

period six years subsequent to the date of the patent. But independently of priority of date, it will be seen on close examination that the two systems differ both structurally and economically, the only point of resemblance being the form of the joists, which are alike, except that the French joist is made to taper towards the centre, or neutral axis. The peculiar form of intertie adopted in Paris is available where plaster is abundant, the chemical constituents of this material enabling it to set so rapidly, that a considerable open space can be filled in without any intervening support. These interties however are necessarily much more expensive than the strips upon which the concrete is laid, in my system, and which are the mere refuse of a builder's yard. The material used for filling in is different, both as regards its thickness, its tendency to expand, its possible effect on the iron, and the strong affinity of gypsum for ammonia; and the final results of the two modes of construction are different,—the one producing a finished floor, admitted to be subject to deflection, with an ordinary load, and the other producing a floor of very great rigidity.

In illustration of the method of applying this system in cases of extended bearings, where the use of girders is necessary, the drawings Nos. 2 and 3 and from 7 to 11 are exhibited. No. 2 is a section illustrating the application of the system with both girders and joists of cast iron, and shews the method of construction employed at a large flax mill at Newry, the plan of one floor of which is given in No. 3, an Ironmongery Warehouse at Bristol, St. Mark's College, Chelsea, the Metropolitan Convalescent Asylum, and various other public and private buildings. The girders, a section of which is shewn, bear either upon columns or walls, and the joists, which are shewn in elevation, run at right angles to the girders, and are cast with a shoulder to drop over the flange of the girder, and form a tie. The depth of the girders is of course in all cases adapted to the span, and when this depth is greater than the thickness of the floor, an intermediate flange, supported by side feathers, is cast upon the girder. The projection below the ceiling line should be covered either with plaster or fire-proof cement, and take the form of a moulded beam, as shewn in the figure, drawing No. 2. The thickness of the floor in this construction rarely exceeds 10 or 12 in., and the saving of space as compared with the iron girder and brick arch system, will be understood from the fact that a depth of 20 in. is required at the springing line of the arches. This difference, in a mill or warehouse several stories in height, will either economize 3 or 4 ft. of walling all round the building, or give an increased height in the different floors. Drawing No. 7 shews the combination of wrought iron boiler plate girders and cast iron joists, as adopted at the recently erected extensive additions to Guy's Hospital, where the rooms are from 21 ft. to 30 ft. wide. The main girders have cast brackets riveted to the web to receive the joists, which are of cast iron with shouldered ends, to drop into the brackets: considerably more than an acre of floor has already been so constructed in this building. Drawing No. 8 shews the application of wrought iron exclusively; both girders and joists being of this material. The girders, which are also of boiler plate, have an additional or intermediate flange of angle iron, to give the requisite bearing for the joists; which latter are of rolled iron, and are occasionally tied to the girders by small angle plates, bolted or riveted on. This application of the principle has been adopted in various public buildings, (amongst which may be mentioned, the Foundling and Brompton Hospitals, the New Offices of the London and Brighton and the Bristol and Exeter Railway Companies, Her Majesty's New Highland Residence, Balmoral, &c.), 42 ft. being the extreme width of bearing to which it has been at present carried; but there is no difficulty in extending it much beyond this, as the adaptation of boiler plate girders to this system of construction, combined with joists of rolled iron, provides for every possible contingency, whether as regards width of bearing, strength of floors, or liability to impact, or vibration. In cases, however, where the use of columns can be admitted to shorten the bearings to 9 or 10 ft., the same advantages may be secured by the adoption of rolled iron, for both girders and joists, thus avoiding the use of riveted plate and angle iron girders, the labor on which necessarily makes them

somewhat expensive. Diagrams illustrating this double application of rolled iron are shewn, drawing No. 9 being the plan of a floor 63 × 28 ft., with a row of cast iron columns running down the centre: these columns support a line of rolled iron girders, which pass through a hole left in the top of the column, as in drawings Nos. 10 and 11. The joists are carried over the backs of the girders, and are rolled of a length to span the full width of the building, including the bearing on each of the side walls. The advantage of having the joists rolled in long lengths, and fixed with an intermediate support on the main girders, is a most important one, not only as affording an efficient tie to the building, but as greatly increasing the strength of the floor; this is an advantage which is peculiar to the use of wrought iron. The ends of the joists may be either pierced and secured to the walls by a rod or S piece, or they may be bolted to a plate of iron built into the wall. The extreme ends of the girders being also secured to the walls, a tie in each direction is given, and the whole forms a framework of wrought iron, possessing immense strength, each part affording efficient aid to the rest. In buildings of greater width, the addition of another line of columns would enable the same arrangement to be adopted; the joists being in that case rolled in long and short lengths, placed alternately so as to break joint, and bolted or riveted together at the points where they take a bearing on the girders.

I have already remarked, at the former Meeting, that from prejudice against cast iron joists, though they have been very extensively and successfully used, I was induced three or four years ago to turn my attention to wrought iron. But here I had to break entirely new ground, to institute experiments, and to overcome many obstacles from the manufacturers. The main question was as to sufficiency of strength in a section of a form best adapted for the purpose—the I shape—but for the manufacture of which no rolls were in existence. Experiments were therefore tried on ⊥ shaped bars, and a formula deduced from these, and acted upon by my having rolls prepared from 4 to 8 inches deep of the I section. Subsequent experiments on these had fully verified the correctness of the formula, but I had not carried my experiments more than 60 per cent. beyond the limit of elasticity, this amount of strain producing a permanent set of only $\frac{3}{40}$ of an inch. I had heard that iron joists were coming into use in France, but knew nothing of the strength they employed, and have never seen either the joists or floors to this day. I have however recently obtained some information as to the strength considered sufficient in Paris: a friend who is about to build there had sent me some particulars obtained from the engineer of the company manufacturing the joists, and a printed statement of experiments on their strength. This information and these experiments are important as bearing on the question of cost, to which I will almost immediately refer. It seems that under no circumstances, and except in a very extraordinary case, would they place the joists less than from 70 to 80 centimètres apart; and for a floor of 6 mètres, joists 12 centimètres deep, and weighing 14 or 15 kilogrammes per mètre, would be used.

I think the first point to establish is the sufficiency, or rather the actual strength, of the joists, of the scantling used in Paris, and the table of experiments enables us to examine this:—

Joists of 12 centimètres deep, and weighing 15 kilogrammes per mètre, were proved at bearings of 4, 6, 8 and 10 mètres. Converting these into English dimensions, we have for the bearing of 6 mètres, 19 ft. $8\frac{1}{4}$ in.; for the depth of the joist, $4\frac{3}{4}$ in.; for the weight per ft. run, 10 lb; and for the mean distance apart, 75 centimètres, or 30 in. From the table I find that a joist of these dimensions was proved at 6 mètres bearing with 2000 kilogrammes on centre, which is equal to 4000 distributed, or 8800 lb. English. The area of floor this joist would carry is—

19 ft. 8 in. × 2 ft. 6 in. = 49 ft. 2 in. and 8800 lb. ÷ 49 ft. 2 in. = 179 lb. per foot super.

But a similar joist was proved with the same weight at 8 mètres bearing, which is equal to 5333 kilog. at 6 mètres:

5333 kilog. = 11730 lb. English ÷ 49 ft. 2 in. = 240 lb. per foot super.

But even this did not reach its limit of ultimate strength, for the joist was further tested at 10 mètres bearing, until the deflection was increased to the extent of just 50 per cent. beyond the last load. It may therefore be safely assumed, that a load of 300 lb. per square foot of floor, would not have broken the joist.

None of the joists I use have been tested to anything like this extent, for as I have said, I have proceeded upon the principle that the joists should not be loaded beyond their elastic limit. We however easily arrive at the strength of such a joist as I have been referring to (for the purposes of comparison) by adopting the simple and universally received formula, that the strength is as the depth^2 × thickness, and I will reduce both this joist and the one I have used (and which forms the basis of my calculations of comparative cost with a timber floor) to rectangular bars, and compare them:

Taking first the French joist—a weight of 10 lb. per ft. gives a sectional area of just 3 square in.; and a rectangular bar of this area and $4\frac{3}{4}$ in. deep, would give the following result:—

15 kilogrammes per mètre = 10 lb. per ft. = 3 sq. in. = $4{\cdot}75^2 \times {\cdot}63 = 14{\cdot}214$

while the English joist = 16 lb „ = 4·8 „ = $7^2 \times {\cdot}686 = 33{\cdot}614$

And further,—

$14{\cdot}214 \div \overline{19'.8'' \times 30''} = {\cdot}289$ per square foot,

and $33{\cdot}614 \div 20'.0'' \times 24'' = {\cdot}840$ „

Giving the result of a comparison of strength just 1 to 3; while a comparison of weight would stand thus:

Each French joist carries 19′.8″ × 30″ = 49′.2″ and weighs 220 lbs. = 450 lb. per square.

Each English joist „ 20′.0″ × 24″ = 40′.0″ „ 352 lbs. = 880 „

Very nearly as 1 to 2.

Now the conclusion seems unavoidable, that if, as I have demonstrated, the breaking load of the French scantling of joist is equal to 300 lb. per square foot, it is in my case equal to 900 lb. per square foot; but even this is assuming that no strength whatever is derived from the principle of construction, while I believe that with properly constructed floors, that is, with good concrete of the proper thickness, these results, satisfactory as they are, may be increased by at least 50 per cent.

Turning now to the question of cost, the following statement has been prepared of the approximate comparative cost of a floor for a room 12 ft. square, and for one 20 ft. square, constructed on the fire-proof principle, and with timber. The results are as follows:

	Room 12′:0″ × 12′:0″			Room 20′:0″ × 20′:0″		
	£.	s.	d.	£.	s.	d.
Fire-proof floor, formed with strong joists of rolled iron, and a cement surface	7	14	10	32	4	3
Deduct excess of iron in joists to reduce them to the strength of the French scantling	1	17	10	10	12	1
Cost of fire-proof floor	5	17	0	21	12	2
Add difference of cost between 1 in. flooring boards and a cement surface 25s. per square	1	16	0	5	0	0
Cost of fire-proof floor with boarded surface	7	13	0	26	12	2
Cost of timber floor pugged	8	15	4	31	12	3

These calculations are made with the price of iron nearly 50 per cent. above that of eighteen months ago, and much dearer than for many years past.

The details of these calculations are given below:—

Room 12′ : 0″ × 12′ : 0″.

Fire-proof floor formed with strong joists of rolled iron and cement surface:—

Five rolled joists, 13′ 3″ long, 8½ lbs. per foot—113 lb. each—5 cwt. 5 lbs. @ 15*s.*		3	15	8		
Concrete, &c., ceiling and cement surface of floor, 55*s.* per square		3	19	2		
		£7	14	10		
Deduct excess of iron in joists to reduce them to the strength of the French scantlings, £3. 15*s.* 8*d.* ÷ 2		1	17	10		
Cost of fire-proof floor					5	17	0
Add difference of cost between 1 inch flooring boards and a cement surface, 25*s.* per square					1	16	0
Cost of fire-proof floor with boarded surface					£7	13	0

Timber Floor—

11 joists, 13′ 6″ long, 9″ × 2″ = 18½ cubic feet @ 3*s.*		2	15	6		
Wall plates, 24 ft. run, 4½″ × 3″ = 2¼ „		0	6	9		
Herring bone strutting, 3*s.* per square		0	4	6		
Half brick trimmer and centering, 4′ 0″ × 2′ 0″		0	8	0		
144 ft. sup. 1 in. flooring boards, @ 35*s.* per square		2	10	5		
16 yards lath and plaster ceiling, @ 1*s.* 4*d.*		1	1	4		
144 ft. sup. fillets, sound boarding and pugging, @ 20*s.* per square		1	8	10		
Cost of timber floor, pugged					£8	15	4

Room 20′ : 0″ × 20′ : 0″.

Fire-proof floor formed with strong joists of rolled iron and cement surface:—

Nine rolled joists, 22′ 0″ long, 16 lbs. per foot—352 lbs. each—28 cwt. 1 qr. 4 lbs. @ 15*s.*		21	4	3		
Concrete, &c.—ceiling and cement surface of floor, 55*s.* per square		11	0	0		
		£32	4	3		
Deduct excess of iron in joists to reduce them to the strength of the French scantlings, £21. 4*s.* 3*d.* ÷ 2		10	12	1		
Cost of fire-proof floor					21	12	2
Add difference of cost between 1 inch flooring boards and a cement surface, 25*s.* per square					5	0	0
Cost of fire-proof floor with boarded surface					£26	12	2

Timber Floor and Ceiling of a substantial kind—

17 joists, 22′ 0″ long, 12″ × 2¾″ = 85¾ ft. cube, @ 3*s.*		12	17	3		
Wall plates, 40 ft. run, 4½″ × 3 = 3¾ „		0	11	3		
2 wrought iron ties, ¾″ diam. with screws, &c., 40 ft. @ 7½*d.*		1	5	0		
Herring bone strutting, 3*s.* per square		0	12	0		
Half brick trimmer and centering, 6′ 0″ × 2′ 0″ @ 1*s.*		0	12	0		
4 squares 1¼″ battens, @ 42*s.* per square.		8	8	0		
44½ yds. lath and plaster ceiling, @ 1*s.* 6*d.*		3	6	9		
4 squares fillets, sound boarding and pugging, @ 20*s.*		4	0	0		
Cost of timber floor, pugged					£31	12	3

Mr. Barrett stated, in reference to the practicability of reducing the scantlings of the joists on his principle, that although it might not be desirable to reduce them to the French standard, he had no doubt rolled iron joists of an intermediate strength between those used in Paris and his own, might be employed with safety, and thus bring down the cost of a fire-proof floor with a boarded surface to that of an ordinary pugged timber floor. M. Thomas, an eminent Parisian builder, had adopted Fox and Barrett's principle in several houses in Paris, using joists of the strength generally employed there, and he had found the floors superior to the French system, which was defective from its want of rigidity, and from allowing the transmission of sound when the hollow pots were used in combination with the plaster. Mr. Barrett concluded by observing, that it might be considered that he had a personal interest in advocating the English system. Undoubtedly as the proprietor of the patent, to a certain extent he had; but his interest in the patent was for a very limited period,—a period which would be totally inadequate to repay even one-half of the very large sum which had been sunk in establishing it. Independently of personal considerations however, the subject was one of general interest; and as the losses by fire in this country were reckoned by millions of pounds annually, he might say it was one of national interest. Certainly, the general introduction of a system which must promote the use of iron (a material for the production of which our resources were unlimited, and in the manufacture of which native skill only was employed) should be encouraged in every possible way.

The Chairman, Mr. Mocatta, V.P. said, that as architects they must feel the importance and advantage of an incombustible and imperishable floor. With reference to cost, it appeared desirable to ascertain the degree of lightness which would be free from vibration and deflection, in order to avoid a very expensive

mode of construction. Mr. Barrett's system was, he believed, the development of that executed some years ago in Gloucestershire by Dr. Fox, which excited much interest at the time. With respect to one matter of detail in Mr. Barrett's system,—namely, the small laths placed between the joists to receive the concrete, he inquired whether those laths were not very slight to carry so great a weight, as if they were liable to become bent, the consequence would probably be a cracked ceiling.

Mr. Barrett stated that these laths were merely used as a support to the concrete, till it became set. They were 1 in. square by 24 in. long, between the bearings on the iron joists; the weight upon them being only $\frac{1}{16}$th of their breaking weight. As the concrete became set, the structure became wholly independent of these strips, and if it were practicable to remove them, the structure would for any purposes of strength be complete without them. He had constructed many acres of flooring in this way, and not the slightest difficulty had arisen from the cause suggested.

Mr. Tite, Fellow, said, it appeared to him that the present question was a little involved in a discussion raised some time ago by the late Professor Cowper, who had brought before the Institute the wonderful merits of construction adopted in the Crystal Palace, and told them that they were behind hand in all inventions, and had to learn everything from the Engineers, especially the use of iron. Now he, Mr. Tite, freely admitted the ingenious application of familiar principles which the French system of flooring displayed; but the question of cost, referred to by the Chairman, was probably the main reason why iron joists of this character had not been more extensively used. Architects had certainly been taught by the Engineers to be more extravagant than they used to be, but to an architect the question of cost must be one of the gravest consideration. It was true that in Paris they had seen a great deal of the application of wrought iron joists by Visconti and others, but he felt bound to claim a perfect acquaintance with this matter in his own experience of some twenty-eight years. There was, in fact, nothing new in the principle, either as respected the iron or the concrete. Mr. Tite then adverted to the early methods of forming floors: first by a row of beams placed side by side, the least dimensions downwards, and of an uniform substance, and afterwards by means of strong heavy girders or bearing beams of oak, producing the greatest possible rigidity. This system, introduced in Italy, was adopted by Sir C. Wren, and when (after the fire of London) oak became scarce, fir was used in the same way. This however, being more elastic, was found to bend, and a system of trussing girders by the insertion of iron was adopted, and gradually carried to a great extent. (Mr. Tite described, and illustrated by sketching, several of the varieties of trussed girders formerly in use). Sir Robert (then Mr.) Smirke at length introduced the cast iron girder, and the use of concrete (the latter in the foundations of the Penitentiary, which had failed). Feeling the defects of the old systems of flooring, and believing that they might be remedied by the employment of cast iron girders, Sir R. Smirke, after consulting Mr. John Rennie, introduced the use of them, and had told him (Mr. Tite) that the first he used was of the extraordinary length of 34 feet, without a support between the walls. The next step was made by Mr. Farrell, a smith, who was employed under Sir R. Smirke at the Custom House, and he, regarding cast iron as a very brittle and dangerous material, proposed the use of wrought iron, for which he took out a patent; and between that system of Mr. Farrell's, and the systems now under discussion, there was in fact no difference whatever, except in the ingenuity of the means which had brought to bear upon the latter. In France earthen pots or plaster were used with iron rods between the joists, in England concrete and wooden laths; but these were merely improvements on the patent of Mr. Farrell, who suggested that the space between the joists might be filled in with any fire-proof material. The joist adopted by him was of this form ⊥, and as he could not get rolled iron, he rivetted the parts together. Mr. Tite stated, that he had used the system described, many years ago in a large public school, where a cheap fire-proof floor was required, with complete success, and when he last saw this construction it was as perfect as when first erected. The space between the joists was in this case about

4 ft. and filled in with 4 in. and 6 in. Yorkshire landing, which gave a good upper as well as under surface, the interstices being filled with Roman cement, and the ceiling formed of the same material. This was applied to a space of 300 feet long, and on an average 15 feet wide. Important as this subject was, Mr. Tite proceeded to express his opinion that, the systems of flooring referred to, were not applicable to architecture in its more important forms. They might do for a range of offices, an hospital, or any building where plain ceilings were sufficient; but the architect had to consider decoration, and must apply his means accordingly; and it would often happen that the ordinary mode of construction introduced by Sir R. Smirke, with subsequent improvements, was better adapted to such purposes, than novelties of more recent invention. With regard to fire-proofing, the world was not satified with actual safety, but required that no part of a building should be combustible, even if no danger could arise from its becoming ignited. Thus, at the Royal Exchange, where he had employed cast iron girders, with arches in cement, the improper substitution of a new stove for the one fixed by his directions, had caused fire to communicate to the frame of a blank window. This frame however might have been entirely consumed without the slightest injury to the building, but the public was not satisfied: an inquest was held as to the cause of the fire, and great complaints were made that the building was not incombustible in every part. With regard to the safety in the use of concrete, as a protection from fire, especially when the concrete was only a few inches in thickness, Mr. Tite expressed much doubt, considering it inferior to the York landings employed by himself as above mentioned. Mr. Farrell had sent to Sir R. Smirke a description with drawings of his method, and the reply of Sir Robert was that he had done the same thing himself for twenty years, only turning the girder with the flange upwards ⊤, instead of downwards. Whether Sir Robert had done this in cast or in wrought iron however, and to what extent did not appear. He, Mr. Tite, should have used wrought iron joists upon Mr. Farrell's plan more generally, but for the improvements and popularity of cast iron girders; and should certainly have employed iron much more extensively, but for the great question of expence. He was very glad the subject had been discussed, as it would be of the greatest possible advantage, if a cheap and durable floor could be constructed, which should be fire-proof in the honest sense of the word.

Mr. T. H. Wyatt, V.P. considered that the present was not a question of precedency, but of general applicability; and as he had been one of the first to use Messrs. Fox and Barrett's system extensively, and had employed it to the extent of 1400 or 1500 squares, he begged to say a few words in its favor. In the Wiltshire Lunatic Asylum, erected by him, it was essential that the estimates should not be exceeded. Originally a judicious system of pugging had been contemplated, but by the adoption of Fox and Barrett's system, not one shilling had been added to the cost, and the results had been most satisfactory. He had tested the deflection of the joists employed, and found it very slight indeed, and he was convinced that any sound wall would bear the weight of this construction, amounting as it did to not more than 78 lbs. for each superficial foot of flooring. Mr. Wyatt confirmed the experience of Mr. Piper as to any needless doubts which might be felt respecting safety of the construction, until rigidity was imparted to it by the concrete filling in. This desirable result however was obtained in a most remarkably degree. In the building referred to he had used joists up to 16 ft. bearing, but others of larger bearings since employed had been equally satisfactory. He had felt some misgivings as to the possible decay of the wooden strips resting upon the joists, but he believed that, as Mr. Barrett stated, they might with safety be removed as soon as the concrete had set. The only serious doubt was as to the action of any damp which might arise from the concrete, supposing the wooden floor to be laid covering it before it had had time to become thoroughly dry. He had used a boarded surface of floor with this system, though if he were building a house for himself, he would prefer one of cement. There were (he believed) no wooden floors in the asylum built by Dr. Fox. With respect to the depth of the iron joists, he had examined Mr. Barrett's calculations, and was

convinced they were free from all possible risk, and might be made from a considerably reduced formula, and yet be within the mark of safety. Mr. Wyatt then adverted to the action of a body of flame upon ordinary plaster, and described some experiments made by Mr. Hardwick at the St. Katharine's Docks, in which plaster slabs $1\frac{1}{8}$ to $1\frac{1}{4}$ in. thick, screwed to the underside of the wooden joists, were exposed to violent flames from tar barrels, and shewed that very little fear need be entertained of the effect of fire upon a ceiling, even if the whole contents of the room were to become ignited. From this he inferred that the laths employed in Fox and Barrett's system did not constitute any objection to it; and he added that he considered it one which was really well deserving the attention of the Members of the Institute.

Mr. I'Anson, Fellow, also spoke in favor of Fox and Barrett's system, and considered that although both that and the French system might have some analogy to the old methods described by Mr. Tite, they shewed a great advance upon those methods. The concrete and other substances were superior to York landing, inasmuch as they tightened up the joists, and gave its chief value to the construction. The elasticity of the joists, until they were filled in, was most remarkable, but in about six or eight months after completion, the floor became perfectly rigid. He had employed Mr. Barrett's system in a large dwelling house, 45 ft. by 26 in dimensions, and the cost of the iron did not exceed £90.; the whole of the timber being saved.

Mr. Tite explained that the York stone in Mr. Farrell's plan was perfectly connected with the iron by means of the cement.

Mr. Boulnois, Associate, stated that it had been asserted by Mr. Brunel, that the concrete was very liable to become disintegrated, and so to part from the joists in Fox and Barrett's system, and to leave them hanging up like so many laths. He had used the system for a 19 ft. bearing three years ago, employing joists without any upper flange, but the floor was subject to considerable vibration, which might be increased beyond the control of the architect—for instance, if used for dancing. He wished to know if the concrete formed a rigid slab equivalent to the stone employed by Mr. Tite; and whether in Mr. Barrett's experience he had ever found the concrete shaken off from the joists.

Mr. Barrett said that he had not. The concrete could not be acted upon from below, nor from above, except by a complete disruption of the upper part. He considered that Mr. Boulnois was altogether begging the question by assuming the fact of vibration, which he could not allow to be taken for granted. After an experience of twenty years with bearings of as much as 18 feet, subject to all the ordinary wear and tear of a dwelling house, he could not conceive the possibility of such a result as the concrete becoming loose.

Mr. Boulnois could confirm Mr. Barrett's opinion by his knowledge of the floor at Messrs. Nurse's coach factory, in Regent Street. There was a sag in that floor, in consequence either of the joists not being cambered, or not being supported in the middle; but that sagging had never increased, although the floor was subject to very great vibration from carriages being moved over it, nor had the concrete been disintegrated. These, however, were matters which patentees ought to be able to speak to, without leaving architects to find them out.

Mr. Barrett said that he had no means of finding out such a fact, which was not necessarily correct simply because Mr. Brunel had asserted its possibility. He must be content with referring to his own experience, confirmed as that had been by Mr. Boulnois himself.

Mr. Tite called attention to the question of Mr. Boulnois as to the degree of strength and rigidity of the concrete, taken alone; and objection to a wooden floor over the concrete on the score of expense.

Mr. I'Anson adverted to the advantages of Portland cement for a flooring.

Mr. Piper, Visitor, said that his own gateway was covered with rolled iron joists, filled in with common York paving, and then (to meet the requirements of the old Building Act) covered with concrete

so as to make a thickness of 14 inches. He had, however, ceased to use this method, observing that York paving was exceedingly destructible by fire, and that practically it did not furnish a fire proof floor. With reference to the doubt suggested by Mr. Boulnois, he believed the patent floors would be found to move altogether, if at all; that there was in fact a close union between the concrete and the metal, and no distinction in the amount of vibration of each. A floor over a stable, subject to all the wear of a loft and granary, had stood for six years (covered with Portland cement) without the slightest disintegration. Mr. Piper concurred with previous speakers as to the resistance of plaster to the action of fire, and therefore considered the laths used by Mr. Barrett were perfectly safe.

Mr. Tite enquired what experience there had been of the action of fire on concrete. He apprehended if there were flint stones in it the concrete would split and yield under the action of fire.

Mr. White, Visitor, referred to the fire at Mr. Ald. Humphreys's warehouses, in February 1851, where he believed the concrete alone prevented the spread of the fire to the vaults, which were filled with valuable and combustible goods.

Mr. Barrett read an extract from the Times Newspaper of the 21st February, 1851, in confirmation of this statement. He added that several fires had occurred in the building erected by Dr. Fox. On one occasion all the furniture in a room, and on another occasion a four-post bedstead and furniture, had been reduced to ashes without injury to the ceilings. Mr. Piper could probably explain the circumstances attending the fire at Messrs. Collard's manufactory at Camden Town.

Mr. Piper said that there the upper floors were on iron girders, but not fire proof. The basement was covered with a light ceiling on Fox and Barrett's patent, and with ordinary care on the part of the firemen it would have preserved the property below. The firemen however would not interfere, and what was termed a second fire took place and destroyed the contents of the basement story. Mr. Barrett read the official report of Mr. Baker, the district surveyor, to the official referees, describing in detail the circumstances referred to, and which concluded thus: "From the foregoing statement, there is no reason "whatever to doubt the efficiency of Fox and Barrett's patent, when applied as a sound fire-proof party "structure; on the contrary, I am well pleased with it, and even with its resistance to very great concussion, "when the latter is spread over a surface; I only wish it had resisted the single and more *pointed* attacks "as well as the combined." These "pointed attacks" refer to the fall of iron columns and girders from a height of 30 ft. upon a fire-proof ceiling, never intended to carry anything but itself.

Mr. Tite contended that York stone would not yield to a fire above it, and again inquired for any proof of the effectual resistance of concrete to the action of fire.

Mr. Barrett said his system had resisted fire in dwelling houses frequently, but it had not been tested by a fire in any large warehouse.

Mr. Scoles, Hon. Sec., observed, that if the ceilings were plastered where these fires occurred the concrete had not been tested.

Mr. Hesketh, Fellow, thought the case of Mr. Ald. Humphrey's warehouses unsatisfactory as a proof of the value of concrete. The fire did not get under that floor, and it was protected from above by the rubbish which fell upon it.

Mr. Boulnois contended it was the duty of the patentee to settle this point, which he might easily do by erecting an experimental house and setting fire to it.

Mr. Donaldson, Hon. Sec. For. Cor.—No architect would use such a ceiling without plastering it, and it was in evidence that intense and long continued heat would not damage the plaster.

Mr. Boulnois complained that insurance companies made no reduction in their charges where the patent was used. If the patentees proved it to be fire-proof this object might be attained.

Mr. Barrett said this rested with the proprietor of the building. The house in whch his own offices

were, cost £3000. or £4000., and was only insured for £600., just to cover the little damage that could arise. Mr. Tite having referred to covenants to insure leaseholds to two-thirds the value, Mr. Wyatt said he had advised the Wiltshire magistrates not to insure their lunatic asylum; and Mr. Barrett said that in the case of the Royal Porcelain Works at Worcester, where his system had been introduced, the insurance had been reduced from 7s. 6d. to 1s. 6d. per cent.

Mr. C. H. Smith, Visitor, referred to the causes which rendered some of the varieties of laminated York stone, used for fire-proof construction, more destructible by fire than others. Those termed self-faced, having been naturally divided, and containing more clay to absorb moisture, which would be converted into steam by great heat, and consequently split, were the most unfit for the purpose. Under ordinary circumstances he was of opinion that concrete, properly made, would bear a very considerable degree of heat; perhaps more than Yorkshire stone.

At the suggestion of the Chairman, the discussion was again adjourned.

ON THE FRENCH AND OTHER METHODS OF CONSTRUCTING IRON FLOORS.

Being a Discussion (in continuation) held at the Ordinary General Meeting of the Royal Institute of British Architects, February 6th, 1854.

The Discussion of Mr. Burnell's paper "On the French Method of Constructing Iron Floors" being resumed, Mr. C. C. Nelson, Hon. Sec., observed that on comparing the French and the English systems, which had been brought under consideration, one great point of similarity was found between them, inasmuch as the main supports in each were the rolled iron joists; on the other hand these joists were much closer together in the English than in the French system, in which latter, however, the iron entretoises, or transverse rods, were placed further apart than the wooden laths in the English system; while the material used for the filling in differed materially, being plaster of Paris, or plaster and hollow earthenware pots in one case, and concrete, formed of lime, sand and gravel, in the other. Neither of the systems under discussion could be considered perfectly novel; and indeed, so far back as the year 1849, a paper was read to the Institute by Mr. Donaldson, describing a mode of construction adopted by an engineer named Thompson, in a bridge over a railway near Glasgow, in which tubular iron girders, of boiler plate $\frac{3}{8}$ in. thick, were made solid by the introduction of concrete between the plates to render them unyielding and rigid; the girders being then tied and framed together with bars of iron, the space between them was filled in by arched brick work. With reference to the question which had been raised at the former meeting as to the expansion of concrete, Mr. Nelson referred to the "Essay on Concrete," by Mr. Godwin, in the first volume of the Transactions of the Institute, for which the first medal of the Institute was awarded in 1836, as containing (in pages 23, 29, and 39,) the results of experience on the subject, clearly proving that concrete in setting did expand. As to the nature of the French plaster, M. Delassaux had forwarded the following communication in 1846, describing the difference between that material and the "plaster of Paris" used in this country, from which it would appear that the former was a much better material than the latter:—"The English plaster stone is a sulphate of lime, destitute of water, except a small portion of sulphuric acid; it is in fact an imperfect alabaster. The consequences of the chemical composition of this stone are, that burnt and reduced to powder in the usual way, it is not capable of resisting the vicissitudes of the weather, and the small quantity of sulphuric acid it contains prevents its setting quickly or becoming hard. It can consequently only be employed for interior plastering, and generally for works requiring but little solidity—its employment in construction is thus very limited. The stone of the French plaster of the environs of Paris is a sulphate of lime composed in the best proportions, the acids being almost equal to the bases; properly burnt it preserves all its acid properties, and reduced to powder and mixed it becomes very hard in one day. Unlike the English plaster there is no need to grind it very fine, on the contrary for strong work it is better to be rather coarse; it is only in decoration that it is employed as fine as the English. In France, along the borders of the Seine, the houses are constructed with this material; for solid construction, grouting the joints of stones, for exterior and interior decoration, and masonry generally, plaster of Paris is employed; for the latter purpose the powder is used rather coarse; mixed with water it forms a factitious crystallization, which adhering to the materials employed gives them greater rigidity—thus a vault formed of stones badly dressed and ordinary mortar would have but little strength, but the use of plaster with its properties of adhesion and augmentation of volume would insure solid and durable work." In February 1849, Mr. Charles Barry read a paper describing a system, patented

by Mr. Beardmore, C.E., in which the same reliance was placed upon concrete, formed of Portland cement and shingle, for stiffening wrought iron, as in Messrs. Fox and Barrett's flooring, drain pipes being in some cases introduced with the concrete for the purpose of lightness. For a span of 20 ft., iron plates, 12 in. deep, $\frac{1}{8}$ in. thick, and 2 ft. 6 in. apart, were used, a layer of concrete, 5 in. thick, being placed between them, on horizontal plates of iron, $\frac{1}{16}$ thick, secured by rivets to the sides of the upright bearers. The author thus described the use of the concrete. "The uniform pressure of the concrete against the surface of the web, and under the upper flanges of the beam, produces the effect of a continuous strut, and enables any sheet, however thin, to assume the true character of a beam or girder." For a span of 15 to 18 ft. the depth of floor would be $7\frac{1}{2}$ in.; from 16 to 20 ft., 12 in. Mr. Beardmore "considered his floors to be fire-proof from their mode of construction; not liable to disintegration when exposed to fierce flame, as brick arches are by their falling off in flakes, nor to be destroyed by sudden cooling when highly heated. The thinness of the floor, when contrasted with one of cast iron, and the absence of all lateral pressure, and consequent necessity for tye-bolts, were further advantages; in addition to which the concrete was a necessary element of the floor itself, not a weight independent of it, and it rendered the whole, as it were, one continuous beam, thus making it nearly impossible to accumulate a great weight on any one spot." Mr. Nelson added that he had received communications on the subject under discussion from Mr. C. H. Smith and Mr. G. R. Burnell, who were now present.

Mr. H. H. Burnell, Associate, read the following extracts from letters which he had received from Paris, in reply to questions which he had forwarded since the first evening's discussion.

From M. Piot, Sub-Architect employed at the works of the Tuileries and Louvre:—

You ask me for some account of the iron floors we are now using in the new buildings of the Louvre. These floors are generally composed of girders and joists of the I form. The joists are so proportioned that the deflection of the floor under a load of 700 kilog. per superficial metre, or 143 lbs. per square foot, shall not exceed 20 centimetres (or $\frac{3}{4}$ in.) which may be thus explained: We suppose that four persons might stand in the space of a superficial metre (or $10\frac{3}{4}$ square feet), and that their joint weights might equal 300 kilog. or 661 lbs., we add as the weight of the interties, fantons, pottery, small wooden joists, and floors, 50 kilog., making 350 kilog. We double this load to make it equal to walking or dancing, and thus we arrive at the above named 700 kilog. (1544 lbs). M. Piot gives the following Table of the spans, weights, and depths of the joists employed in the floors of the Louvre:—

SPANS.		WEIGHT OF JOISTS PER YARD RUN.	DEPTHS OF JOISTS.
Ft.	In.	lb.	Inches.
6	7	18	4
9	10	22	$4\frac{3}{4}$
13	2	40	$5\frac{1}{2}$
16	5	50	$6\frac{1}{4}$
18	1	54	$7\frac{1}{8}$
21	5	60	$7\frac{7}{8}$
25	0	76	$8\frac{3}{4}$

We have adopted the above mentioned spans, placing the joists 80 centimetres, or 2 ft. $7\frac{1}{2}$ in. from centre to centre, the interties 1 metre, or 3 ft. $3\frac{1}{3}$ in. apart; the fantons are placed 20 centimetres, or $7\frac{7}{8}$ in. from each other, and serve to support the pottery in the usual way. The pottery is thoroughly bedded and plastered on both sides, rendering the floor as nearly as possible sound-proof, and infinitely

superior in this respect to the ordinary methods. The strength may be judged of by the fact that some have been proved to 1500 kilog. per superficial metre, or 307 lbs. per square foot, and the deflection did not exceed 3 centimetres, or 1 in. in the middle. In first class buildings the filling-in is generally of pottery or hollow bricks, but in private houses they usually content themselves with plaster alone, it is considered inferior and less sound proof. In general the wrought-iron floors are found to be of the necessary strength, and may be regarded as a great improvement, but in France, and particularly in Paris, the spirit of speculation is prone to exact too much from the material it employs.

From M. Lebas:—I received the letter you were good enough to send me, and was glad to hear that you had written to M. Piot on the subject, for he is the most capable of giving the desired information, as he unites great experience with practice, which is better than all the theories. He has no doubt given you all the necessary proportions of the floors of the Louvre. Though it is certain that with these floors there is a small amount of vibration, it is no less certain that when used with common judgment they offer the desirable qualities of strength, durability, and incombustibility. Had I to undertake a building of importance I should unhesitatingly adopt this system, which I consider excellent.

M. Charles Hittorff remarks that, for dwelling houses, the weight on the entire floor should not exceed one-fourth or one-fifth of the breaking weight, or limits of deflection of the joists, and that it should bear the weight of four persons = 300 kilog. (661 lbs.) per superficial metre (66 lbs. per foot superficial). When these limits are surpassed, a disagreeable vibration and a disposition to transmit sound is the result. As yet, the floors well filled in with pottery, or hollow bricks, have developed no symptoms of failure, either with respect to vibration or transmission of sound; but they are considerably dearer than those of wood, though the manufacturers (quoting the first or cheapest system) pretend the contrary. This kind of economy is much to be regretted, as it may be the means of causing accidents, which would tend to create a prejudice against this mode of construction. The difficulties of rolling render the production of large joists very doubtful as regards the equality of texture, and in many instances those of from 22 ft. to 24 ft. long, and from $8\frac{1}{4}$ in. to $10\frac{1}{4}$ in. deep, have broken on being proved; but nothing is to be feared from the employment of these methods for moderate spans.

M. Hittorff has never known that these iron floors have been filled in with concrete, which, in his opinion, would be to load the floor unnecessarily. The iron work is painted with a coat of litharge to prevent oxydation; sometimes this precaution is neglected, and without ill effects; for after all, the oxydation can only take place by the double action of the oxygen of the air and water. The iron embedded in plaster is at once covered with a coat of rust, but this action soon ceases when the plaster is of a sufficient thickness (say $\frac{3}{4}$ in.) to exclude the air. This fact is sufficiently proved by the fragments of iron we constantly find, while demolishing our old buildings, in a perfect state of preservation, though they have never been painted.

Lastly, a communication from M. Dumont: Of the two systems of wrought iron floors that you mentioned, this one is almost exclusively employed here. Prudent builders never allow the depth of the joist to be less than $\frac{1}{36}$th part of the span. The filling in between the joists is generally of pottery or hollow bricks, bedded in plaster; when the builder is not too sparing of his plaster, and the spaces properly filled in, the necessary rigidity is obtained. We avoid the use of concrete, on account of its weight; we find nothing answer so well in every respect as the pottery. We paint our iron work with one or two coats of litharge, according as the speculator may be disposed. As to the quality of the work, I may state that, up to the present time, the ceilings have not suffered from discoloration by the oxide of iron; I believe that, in the first instance, the paint is sufficient to protect the iron from the humidity and the corrosive qualities of the plaster, and at a later period, the plaster in its turn protects the iron from atmospheric influences. It must be acknowledged that experience, as yet,

can say little on the matter. In twenty, fifty or a hundred years, we shall be better able to judge of the systems, but at the present moment they are so much in favour with us, that we very rarely have recourse to the old methods. In four houses that we are now erecting in the Rue de Rivoli we have used these floors, three of them opposite the Tour de St. Jacques, and the other (which is the most important) between the Rue de Bourdomais and the Rue des Déchargeurs; we do not yet know the numbers.

Mr. Burnell then read the following remarks:

From these communications we may briefly sum up the following facts:—That the planchers en fer, if properly carried out, succeed, but that they, in common with all other modes of construction, are capable of being executed badly. We learn that the floors of the Louvre, though upon the same principle, are stronger than those ordinarily used for dwelling houses. That joists of the depth and weight indicated in the table furnished by M. Piot, if placed 2 ft. 7½ in. apart and properly filled in, will produce a floor whose deflection shall not exceed ¾ in. in the centre, under a load of 143 lbs. per superficial foot; and that there are others executed in the Louvre that have borne 307 lbs. per square foot, with only 1 in. deflection in the middle. That for the floors of dwelling houses, the weight on the floor should not exceed one-fourth or one-fifth of the breaking weight of the joist, or that the depth of the joist should not be less than $\frac{1}{36}$th of the span, when placed about 2 ft. 6 or 3 ft. apart; and lastly, that no ill effects have at present been experienced from the contact of the iron with the plaster.

As I have before said, my object in drawing your attention to the matter in question was to induce a due appreciation of that which seemed successful, but not to extol it beyond its merits. I think we must all perceive that a valuable lesson is to be learned by the study of these French methods, when we consider their lightness, and the small space they occupy, when compared with the fire-proof floors we have been in the habit of executing. The introduction of interties between the joists must surely be important, when the filling-in is of a material that swells in the process of setting, to say nothing of their use as transverse ties. The ceiling appears to offer its advantages on the score of durability and convenient execution; for how much more easy must it be for the workman to adjust a flat centering beneath the joists, and form the ceiling by the simple operation of pouring a composition in upon it, than the tedious process involved in our own method of lathing, and applying the various coats of plaster, in a very inconvenient position, from the under side. This mode of grouting from above is not peculiar to iron floors, but it requires a material that sets with moderate rapidity, which with us is more costly than with the French.

I believe that the rare occurrence of serious conflagrations in France is mainly attributable to the use of solid plaster ceilings. All seem to agree that the frequent losses by fire, the discreditable condition of many newly-built houses, the fall of others, and the threatening aspect of the many more which must inevitably share the same fate, were there not a special Providence over ignorance and knavery, are sufficient causes to justify any attempt to introduce improvement; and when we consider the rapid occupation of very desirable positions by endless piles of mud and bricks, exhibiting little but a disposition to speculate and low cunning, we must all regret that our already great metropolis should continue to extend itself under the guidance of parties so little capable or disposed to develope constructive or artistic talent.

Mr. Christopher, Fellow, felt called on to offer some remarks upon what had been called the English system, as the results of considerable experience. He had spoken warmly in favour of that system when it was first introduced, and still thought well of it, though it had not been so much improved as he had expected. With regard to the kind of finished flooring used upon the concrete, he observed that Portland cement in connection with elastic iron was objectionable from its rigidity and brittleness; and in many instances within his own knowledge it had cracked. Indeed, he did not know of a case in

which it had remained sound for three years. This had been the case both with floors and with flat roofs, after remaining perfect for twelve months; and, as they were aware, when the Portland cement was once cracked, water spilt would penetrate through the concrete, and in the case of a floor would stain the ceiling below, whilst in that of a roof the damage would be much more serious; as there it was impossible to repair effectually the cement. It was difficult to account for this failure, but probably, as one of Mr. Burnell's French correspondents suggested, it might be owing to the expansion of the concrete. Whether the fault was in the cement or in the concrete, he had had failures in three roofs. However, the system admitted of other modes of finish, and amongst these he might observe that he had found the metallic lava of Messrs. Orsi and Armani quite successful after two years trial. The ceilings on the French system were, in his opinion, better than those on the English plan. In the latter there was the want of a good key, and this was a serious objection where the plaster was $1\frac{1}{4}$ or $1\frac{1}{2}$ in. thick, while under the flanges of the joists and girders there was no key at all, and several serious falls of the ceiling had taken place. In the French system this could not happen, the whole mass being poured in from above; but in the English a separate material was applied to form the ceiling from below. As the object of this discussion was to ascertain the truth, he felt bound to say there had been several instances of ceilings giving way, not only under roofs, perhaps from the faultiness of the cement coating, but also in the floors below, and he had found it necessary very recently to take down the whole of several ceilings, in order to quiet the apprehensions of the tenants on this score. Another serious objection to the English system, especially in London, where expedition was required and ground rents high, was the time necessary for the materials to dry. The drying of a mass of material 8 or 9 inches thick and full of water, if in a confined situation, was indeed almost an impossibility. He had a case in which it had not dried even in two years, and in which it had been necessary to take up the surface of the lower floors entirely, and to employ another material. The floors in that case had been of lime and sand; after the building had been shut up for two months, the workmen (who were provided with slippers) went in to hang the doors, and the surfaces were consequently so worn and broken that they were destroyed. In the lower part of this building Portland cement was substituted for the original finish, and he might observe, as an exception to his former statement, that as a basement finish that material, about $1\frac{1}{4}$ in. thick, answered exceedingly well, the damp tending to preserve it. In this case the cement was laid on a concrete bed, 4 to 5 in. thick, upon the well rammed earth. As he had remarked some years ago, Fox and Barrett's system admitted of the best plans of ventilation and artificial warming, but this point did not appear to have been much attended to. This, indeed, with such a mode of construction, was more necessary than in the ordinary plan. The floors were so solid from wall to wall that no air could get through them, and therefore a special supply was necessary. From the same cause there had arisen a want of draught to the fire places, and consequently smoky chimnies. Mr. Christopher then proceeded to the question of cost, in which he differed altogether with Mr. Barrett. He had gone into estimates with that gentleman when iron was only half its present price, of £15. per ton, and they could not reduce the price of a floor on his plan to the cost of an ordinary timber floor; on the contrary, it was about the cost of a timber floor of the best description, made in the best way. He objected to the course pursued by Mr. Barrett in his calculations read at the last meeting, and to the deductions he had made from the price of his floors in order to bring the cost down to the lowest possible figure. Thus Mr. Barrett made a deduction for an assumed excess of strength, but he (Mr. Christopher) could not admit that for a moment. To any person employing his patent, Mr. Barrett would certainly not recommend any reduction of strength to correspond with this deduction from the price. Indeed, instead of making any deduction from the cost of the patent system, he (Mr. Christopher) thought certain additions should be made. In the first place better foundations were required than for ordinary construction. These would be necessary even in the

country, on a maiden soil, and in a second rate house in Pall Mall he estimated the extra cost for the foundations, which were essential in using this solid and massive description of fire proofing, at £20. In the Thames Chambers, an extra first rate building, upwards of 10,000 feet of hoop iron were used, at a cost of £46., rather more than half of which, or £25., he had considered necessary in consequence of adopting Fox and Barrett's system. Then again, there was the license for the use of the patent to be added, which, in a dwelling house, would be from £10. to £30. It did not appear, moreover, whether the hoisting and fixing of the joists were included in Mr. Barrett's price. [Mr. BARRETT said they were included]. Then expense was incurred in cutting and trimming the joists for chimney breasts and projections which in the case of the Thames Chambers, where there were fifty-five squares of flooring, he estimated at £10. There was the painting the lower flanges of the joists, which he thought very advisable, and more so after inspecting the result of Mr. Smith's experiments on the table, and which the French architects appeared also to think necessary. [The Chairman, Mr. T. H. WYATT, said, the statement of M. Hittorff was that the painting might be dispensed with; that its absence did not seem to produce any ill effects.] In all good rooms it would be also necessary to have a wooden fillet for nailing the carpets to. Mr. Christopher's estimates, framed on the result of his experience, would therefore be as follows :—

FOR A ROOM 12 ft. × 12 ft. = 1 sq. 44 ft.

	£.	s.	d.
Fire-proof floor with cement surface—Mr. Barrett's price, omitting his deduction	7	14	10
Add for extra foundation and bond	1	3	0
License for use of patent	0	14	4
Hoisting, fixing, cutting, and painting—say	0	7	10
	10	0	0
Add extra for boarded surface	1	16	0
	£11	16	0
Cost of timber floor, pugged—Mr. Barrett's price	8	15	4
Excess in cost of fire-proof floor	£3	0	0

FOR A ROOM 20 ft. × 20 ft. = 4 sq.

	£.	s.	d.
Fire-proof floor with cement surface—Mr. Barrett's price, omitting his deduction	32	4	3
Extra coat on ceiling, 44⅔ yds.—at 2*d.*	0	7	5
Extra foundations—at 7*s.* per sq.	1	8	0
Extra hoop-iron bond—at 9*s.*	1	16	0
License for use of patent—at 10*s.*	2	0	0
Hoisting, fixing, cutting, and painting—at 5*s.*	1	0	0
Wood filleting for carpets—say	1	0	0
	39	15	8
Add extra for boarded surface, with 1¼ in. battens, at 32*s.*	6	8	0
	£46	3	8
Cost of timber floor and ceiling of best description, Mr. Barrett's price	31	12	3
Excess in cost of fire-proof floor	£14	11	5

Upon the whole, therefore, he thought Mr. Barrett's estimates were not to be depended upon.

Mr. C. H. SMITH, Visitor, called the attention of the Meeting to some specimens in illustration of the effect of plaster upon iron. In these specimens he had placed different materials in contact with iron on the day after the last meeting (a fortnight ago), and the results were now evident. In one specimen plaster of Paris alone was used, in another plaster mixed with sand, and in another mortar, or lime and sand in equal proportions. In the latter not the slightest trace of rust was perceptible, although the interior of the mass was still in a very soft state, whilst in the other specimens, especially with the plaster of Paris, the iron was sensibly affected. Plaster of Paris decreased in hardness in proportion to its age. As an illustration of this, Mr. Smith stated that he was employed some years ago to remove from the residence of Mr. Prince Hoare, at Bath, to London, eight or ten large casts from the antique, which had been there a hundred years, but he only succeeded in removing two of them safely, the rest having fallen entirely to pieces. Lime, on the contrary, increased in hardness with age, and iron in contact with it was not affected. As the specimens proved, plaster was most injurious. Paint would protect the iron, but if it became rubbed off, even in the smallest pin hole, the plaster would communicate oxydation to the iron, to an extent almost beyond

belief, and, in fact, would in time entirely destroy the iron. He believed it would be found almost impossible to fix iron joists in a building so that the paint or other coating used to protect it should not be rubbed off in some parts, and even galvanized iron was subject to the same objection.

Mr. Garling, Fellow, enquired if the old casts referred to by Mr. Smith had been exposed to damp.

Mr. Smith said they had not; but that there was always a sufficient amount of moisture in the atmosphere to facilitate the decay of plaster.

Mr. Garling referred to some plaster floors which he had seen in Lincolnshire, in the vicinity of the quarries. These consisted of a body of coarse plaster, with about an eighth to a quarter of an inch of fine plaster as a surface, very finely and smoothly trowelled; and although these were from 100 to 150 years old, they were now as hard as marble. He had also occasion to take down the plastering of the walls of some rooms in the same neighbourhood, which was at least 300 years old; this was 30 or 40 years ago, and, speaking from recollection, his impression was that the plaster in that case was quite as hard as in the floors.

Mr. Scoles, Hon. Sec., suggested that these floors were possibly of lime, and not plaster; but Mr. Garling was quite sure they were of plaster.

Mr. G. R. Burnell, C.E., referred to the work of Rondelet—L'Art de Bâtir—on the different nature of lime and plaster as to durability, in confirmation of Mr. Smith's remarks, and read some portion of his letter to Mr. Nelson: "I would call your attention, and that of the members of the Institute, to a work I mentioned on the last evening; it is M. Eck's 'Traité de la Construction, Poteries, Fer, Fonte et Tôle," in 2 vols. fol. Paris, 1841; in which will be found many very remarkable illustrations of the application of those various materials to purposes which rarely are thought of in England. It is an extremely valuable work, and if it had been better known here, probably much money might have been saved by preventing parties from taking out patents for systems already largely employed; and at any rate, the study of M. Eck's book would have suggested many valuable hints to both architects and engineers. At the same time, I would also beg to call the attention of the Institute to a Note I published myself in the Builder of 1849, page 350, in which I gave a short description of the application of the H shaped rolled iron: I allude to this because I have reason to believe that the application of this kind of bar iron to flooring purposes has been patented subsequently to the publication of my note in the Builder. In Paris, it was used, to my knowledge, in 1848." The nature and application of compound wrought iron beams with earthen pots for roofs were described by Eck as known so long ago as 1780, in whose work an account was given of the church of San Vitale, at Ravenna, the dome of which is formed of oil jars, laid horizontally; a fact which would set at rest the question of the supposed novelty of this use of pottery.

Mr. Scoles, Hon. Sec., referred to the use of similar materials, in the Roman period, in Syracuse, and Mr. Donaldson added also that they were employed likewise in the Circus of Caracalla.

Mr. G. R. Burnell read a further portion of his letter to Mr. Nelson:

"The formulæ given by General Morin are as follow: 1st. For the system Vaux, he considers that the bars are exposed to the action of a load distributed equally throughout their whole length, and that the ends are fixed in the walls; the weights and dimensions are calculated in metres and kilogrammes. Then, calling the height of the bars, or main ribs $= b$

Their width - - - - - $= a$

The load per metre lineal - - - $= p$

The clear span - - - - $= C$

The coefficient of the resistance of wrought iron $= 2{,}000{,}000$

$$a b^2 = \frac{p C^2}{2{,}000{,}000}$$

In practice, the load per metre lineal usually applied (at least, for the purposes of calculation) is 53.28 kil., or about 37 lbs. per foot lineal; and the joists or bars are placed at distances of about 2 ft. 6 in. apart.

" 2nd. In the cases where rolled H rails are used, the height b, and the projection of the flanges a^1, are constant for the same class of rail, and the thickness of the flanges is usually $\frac{1}{20}$th of b. The thickness of the centre web e^1 is the only element of the problem in these cases which varies, according to the resistance to be given to the bars. Then, calling the total load $= 2\,P$, and the total bearing $= 2\,C$, and the resistance for this form of section R, $= 6{,}000{,}000$, we have

$$\frac{I}{v'} = \tfrac{1}{6} e_1 b^2 + 0,\ 0903\ a' b^2;$$

in which I = the moment of inertia of the section in function of the height b, and v^1 = the height of the neutral axis of the bar. The ordinary formula $\frac{R\,I}{v'} = P\,C$, then becomes

$$\tfrac{1}{6} e_1 b^2 + 0{,}0903 a' b^2 = \frac{P\,C}{R} = \frac{P\,C}{6{,}000{,}000} \text{ and from this}$$

$$e_1 = \frac{P\,C}{1{,}000{,}000 b^2} - 0{,}54 a'.$$

When the proportions between the thickness of the flanges and the height differ, the general formula becomes $\frac{I}{v'} = \frac{1}{6} \frac{a b^3 - a' b'^3}{b}$, in which b' = the space between the ribs.

" I was not quite correct in the observations I made upon the deflection of these floors, on the occasion of your last meeting, and I therefore send you a translation of an experiment recorded in pages 331 and 332 of vol. IV. of General Morin's 'Leçons de Mecanique Pratique,' which treats of the resistance of materials.

" A floor of about 23 ft. span (7 mètres), on the system Vaux, with joists 2 ft. 6 apart, $7\frac{1}{2}$ in. deep by 0.36 of an inch in thickness, cross ties 0.63 of an inch square, and split rod laths 0.43 of an inch square, the joists bearing about 1 ft. on the walls, was loaded with a weight equal to 102 lbs. per foot superficial over the whole surface. The iron work was set with a camber of about $2\frac{3}{4}$ in. when in place; the filling in with plaster brought this down to 1.58 in.; and when the load was applied, the floor sunk to 1.17 in. below the horizontal line, which deflection ultimately became (after 24 hours) 3.17 in. On removing the load, the floor rose 2 in., and on further removing the plaster filling the iron work, rose nearly to its original camber, or to 2.36 in. above the horizontal line. General Morin remarks that this proves that the iron retained its original elasticity to a great extent, and that the plastering contributed greatly to the permanent deflection.

" Mr. Barrett's objection to the use of the French floors—that they were not perfectly inflexible, and his statement that the plaster used in the Midland Counties was objected to on account of its organic smell, seem both to require notice; for, in the first place, a mere augmentation of the scantlings would give any required rigidity; and, in the second, Mr. Barrett appears to have overlooked the fact that the French plaster, both geologically and lithologically, differs from that of our Midland Counties."

Now, the French plaster contained carbonate of lime, which the English plaster did not. Possibly English plaster, used in large masses, might give out some odour; but certainly he could state from experience that the plaster used in Paris was not open to that objection. Where French plaster was used in conjunction with brick-work, a remarkable degree of efflorescence took place, which might arise from animal matter either in the bricks or in the plaster, or perhaps in both. At all events

animal matter did not exist in the French plaster to any objectionable extent. Mr. C. H. Smith's statement that lime protected iron from rust should be received with caution. All the wrought-iron bridges in France had been built upon the principle laid down by Vicat, that no oxydation could take place whilst iron was immersed in slacked lime; and accordingly the tying-down rods of these bridges were bedded in wells, with a paste of chalk lime carefully rammed in. Yet all those bridges had fallen; that at Angers at a time when 600 person were upon it, more than 400 of whom were drowned. The explanation of this failure possibly was, that the action of the load upon the bridge set the chains in a state of vibration, which, though not perceptible to the eye, was yet sufficient to detach the rods from the lime in which they were embedded; upon which water could get in, and the oxydation would commence. Mr. Smith's principle was correct; but in a floor of any kind there must be some degree of vibration, which would tend to detach the joists or girders from a bed of lime in which they might be placed. He believed, in fact, that concrete or lime in any form was not better than plaster, which being more hygrometric than the mortar would rather protect the iron more securely. Practically, in a house, the plaster was a sufficient defence to the iron, and this was what the French architects meant, when they said they had not noticed any rust in the use of this material.

Mr. Smith observed that it was not necessary that lime should be absolutely in contact with iron to protect it from rust. Thus the dealers in polished steel goods, such as needles, did not coat every article with lime, but merely placed here and there amongst them a piece of quick lime in paper, which kept them in a polished state as long as the lime continued in a caustic condition.

Mr. G. R. Burnell said that this remark did not apply to the French bridges. In the case put by Mr. Smith, the caustic lime not being as yet converted into a hydrate, acted by absorbing moisture from the atmosphere.

Mr. Garling suggested that if the chains of the French bridges were bundles of wires instead of solid bars, the interstices in the wires might have conducted the water into the wells.

The Chairman stated that the names of two gentlemen had been given to him as wishing to offer some remarks upon the subject; and that it would be only fair to Mr. Barrett to allow him to say a few words in reply to Mr. Christopher. As therefore the discussion had already occupied the usual time, he proposed that it should be further adjourned till the next ordinary meeting.

Mr. Barrett, in reference to Mr. Christopher's statement that extra foundations were necessary in using the patent system of flooring, begged to appeal to Mr. Beck, who might not be able to attend at the next meeting. As architect to the Metropolitan Association, that gentleman had erected a building five stories in height, all the floors as well as the roof of which were fire-proof; and he would no doubt bear testimony to the fact that extra foundations were not used there.

Mr. Beck, Associate, said that this was the fact, and that, in the case referred to, he had not introduced any additional brickwork in the foundations, in consequence of using Messrs. Fox and Barrett's floors.

The discussion was then again adjourned.

ON THE FRENCH AND OTHER METHODS OF CONSTRUCTING IRON FLOORS.

Being a Discussion (in continuation) held at the Ordinary General Meeting of the Royal Institute of British Architects, February 20th, 1854.

The discussion, which had already occupied the attention of the three previous meetings, was resumed by Mr. C. C. Nelson, Hon. Sec., reading the following communication from Mr. H. J. Stevens, Fellow, of Derby.

"I beg to offer the following information as to the nature of the floors to which Mr. Garling alluded during the discussion at the Institute on the 6th instant.

"Gypsum, or plaster, from the quarries near Derby, and parts of Nottinghamshiro, is very extensively used for chamber flooring in this district—and its durability, when properly prepared and laid down, fully equals what Mr. Garling asserted. The coarsest description of gypsum is used, and after calcination, is broken down with wooden flails. It is kept in a dry state, and when laid, is mixed with water to the consistence of rough mortar, and spread over the wood joists on reeds or laths to a uniform thickness of 2 inches to $2\frac{1}{2}$ inches. It hardens very rapidly, and the workmen use a long float of wood for levelling it, and on the second or third day, it is polished off with boulder stones or trowels. It is desirable that the surface should not be broken by using the floors too soon after they are laid: it is also usual to give an increased hardness by a coat of linseed-oil, and in Nottinghamshire the floors are painted, and look extremely well. Two sides of the room have wood fillets laid down, varying in thickness with the superficies of the floor, which being removed immediately after it is laid allow for the expansion, which is not only very considerable, but continues for some time. Floors of this material are very strong, and are extremely well suited for cottages, being, in this district, much cheaper than inch white deal—2*s.* 3*d.* to 2*s.* 9*d.* per superficial yard is the builder's price for laying them down, including reeds, laths for securing the reeds, and plaster. The under surfaces of the joists are edged, and sometimes planed, and the ceiling is formed by the plastering of the reeds between the floor timbers, for which an extra 3*d.* per yard is sufficient. These floors are to a certain extent fire-proof, and having a smooth surface are easily cleaned, and afford no harbour for vermin; on these accounts, as well as for their cheapness and durability, plaster floors, as they are called, are almost invariably adopted in the Midland Counties, where the carriage of the material does not operate as an objection. Mr. Garling is wrong as to the *finer quality* being laid over the coarser material. I believe what is herein stated will give you the detail of the process, and I have only further to observe, that it admits of being burnt over again, and it is considered desirable that a certain proportion of old plaster should be mixed with the new; when that is the case the floors are found to set harder. I have seen this coarse flooring plaster used externally as pane work in half-timbered construction, and believe it to have been two or three hundred years since it was worked into the building.

"I offer these observations for the information of the members of the Institute, as there does not appear to be a clear notion of the uses to which the gypsum of this neighbourhood has been applied for many centuries. It is is not improbable that the material may be adopted for flooring in connexion with a system of fire-proof construction, and it might be desirable for some of our scientific members to examine and analyse its composition. I am disposed to disagree with Mr. Christopher as to the extra expense necessarily incurred by the adoption of Fox and Barrett's

system of fire-proof construction, but as the Chairman of the last meeting has given Mr. Barrett an opportunity of replying to Mr. Christopher's statement, I have no doubt that gentleman will easily bring proofs that neither extra foundations, nor hoop-iron bond are required, that the hoisting, etc., are included in Mr. Barrett's statement of *cost*, and that wood filleting for carpets cannot be necessary where a boarded surface is added."

Mr. T. H. Wyatt, V.P., having before expressed a strong opinion in favour of Messrs. Fox and Barrett's system, was anxious that it should not be supposed that he had adopted it without mature consideration. He had heard with surprise and pain the strong remarks of Mr. Christopher, objecting to this system, for he could not but remember that his own attention had been first directed to the patent by a pamphlet of Mr. Christopher's published in 1848, which eulogised the system in a manner, compared with which, any praise which he (Mr. Wyatt) had given to it, was as cold as possible. Certainly, his own experience, together with that of his friends, Mr. Salvin, Mr. Clarke, Mr. Rhode Hawkins, and others, who had used it largely, justified the opinions he had already expressed. He, himself, had never used it for roofs; neither had he used cement floors; and he was strongly of opinion that the failures which Mr. Christopher referred to, had arisen from an injudicious application of the system rather than from any inherent defect. A principal objection raised by Mr. Christopher, was the want of a good key for the ceilings; but having used the system successfully in four or five large buildings, especially in the Wiltshire Lunatic Asylum, where, from the constant vibration in the refractory cells and in the corridors, the ceilings were subjected to the severest test, he felt convinced that any failure elsewhere must have proceeded from bad workmanship; and in this opinion he was confirmed by the friends already mentioned. With respect to the time necessary for the drying of the concrete, he thought it rather desirable than otherwise, that a check should be given to the rapidity with which buildings are now carried up; and in his own practice, he had not found the difficulty to exist with a proper supply of air and provision of fire-places, which did not exist in one of the buildings erected by Mr. Christopher. Mr. Christopher, in his pamphlet, had thus described the excellence of the ceilings at *Northwoods*:—"The ceilings are finished, and appear as usual, but equalling the best, as they remain for fifteen years without a crack!" Mr. Christopher had objected to the solidity of the patent floors, as interfering with the supply of air to the fire-places. He (Mr. Wyatt), thought it was much better to depend upon an artificial supply of air than upon that which came through the interstices of the floor, bringing dust with it; and the objection, if any, applied equally to a good wooden floor, properly tongued and pugged. On the question of cost, Mr. Christopher had now given an opinion directly at variance with that expressed in his pamphlet, in pages 3 and 7, of which he stated that, "Buildings may now be constructed fire-proof without increasing the cost of erection; the above *grand desideratum* in the art of building is now no longer *theoretical*, but a fact supported by just such testimony as could be desired, viz, the existence of a building on a large scale erected throughout in the manner referred to, *which has not cost more* than if it had been constructed in the ordinary way. The roofs—at from one-half to one-third the cost of the usual roof.—*Economical*, rather less costly in first construction, and *much* less in use, from being *indestructible*." As he (Mr. Wyatt), had before mentioned, the adoption of Fox and Barrett's system in the Wilts Lunatic Asylum, had not involved the expenditure of an additional shilling beyond the original estimates. He certainly could not suppose that any extra strength in the foundations was necessary in this system. The only difference in the weight sustained by them, as compared with a case where ordinary floors were used, would amount to four hundred weight on the square foot in a building of five stories; and no prudent architect would make foundations so weak that they could not sustain so small an extra weight as this, a tithe of the crushing weight.

In his pamphlet, Mr. Christopher had expressed a very different opinion, and stated that, "the requisite strength is fully developed by combination and perfect union, giving equally sustained solidity to every part, while from the lightness of the floors and roofs, and their being quite level, (without lateral thrusts) the enclosing walls need not be thicker than usual." For the same reason, he (Mr. Wyatt) did not conceive the use of an extra quantity of hoop iron bonding at all necessary. In the case of the Thames Chambers, referred to by Mr. Christopher, the nature of the locality might have suggested this precaution, which under ordinary circumstances was unnecessary. The objection raised as to the expense of cutting and trimming joists to suit openings and chimney breasts, bore rather hardly upon the system, especially as the patentees took great pains to prepare their joists and girders accurately. Generally, Mr. Christopher had been very severe upon the estimates of Mr. Barrett. He (Mr. Wyatt), had not gone minutely into those estimates, but he had sent them to a Surveyor in whom he could place confidence, who stated that they were perfectly honest, and applicable to the present time. It was not fair to compare this system with a wooden floor, as it should rather be compared with the French or some other kind of fire-proof flooring, and if that were done, he believed the result would be in its favour. After a long discussion on the subject, the Institution of Civil Engineers had approved of the plan, the Inspectors of Prisons and the Official Referees had also treated it as a satisfactory and efficient fire-proof construction; and he had himself found it to answer all his expectations. Whether this system or the French system should be considered preferable, one important point suggested itself in the present discussion, namely, that a very heavy responsibility would rest upon them and their successors, as architects, if they should disregard the fact, that there were systems known by which essentially fire-proof construction could be attained with very little extra expense; and it was their duty therefore to test these systems as severely as possible, and to employ one of them whenever they had the opportunity of doing so.

In reply to some inquiries Mr. Wyatt added that some of the rooms in the Wiltshire Lunatic Asylum were 16 and 18 ft. by 24 ft.; the corridors being 150 ft. by 12 ft. The rigidity of the floors was remarkable, and the only doubt which ever arose in his mind had been caused by the appearance of a dark line on the ceiling immediately under each joist. This he had thought proceeded from some chemical action, but it had been entirely removed by the second coat of lime whiting.

Mr. Papworth, Fellow, referred to the letter of Mr. Stevens of Derby, and inquired what amount of space in proportion to the whole superficies should be left around a plaster surface to allow of its expansion. His own experience suggested that an inch and a half on every side of a floor for every ten superficial feet would not be too much.

Mr. Wyatt concurred in this opinion, and referred to a loft at the seat of Lord Cardigan in Northamptonshire, where the walls had bulged from the expansion of a plaster floor, although a space had been left originally to provide for this occurrence.

The Chairman, Mr. Inman, V.P., stated that floors of plaster, sometimes mixed with coal ashes, were in general use in large mansions in the vicinity of London about eighty or hundred years ago. This was the case in some of the upper floors at Hampton Court Palace, where a layer of cockle-shells about two inches in thickness was also introduced in the floors, for the purpose of deadening sound.

Mr. Boulnois, Associate, observed, that in his experience of Fox and Barrett's system he had never found the ceilings give way, though he had employed plaster of Paris to guage them. From his remarks at a former meeting it might have been supposed that he disapproved of this system, but on the contrary, he thought it an admirable system, and by far the best mode of fire-proofing ever introduced. One great advantage which it possessed was that of economizing height,

which was a point of the greatest importance in London. With respect to Mr. Christopher's opinions as expressed in his pamphlet and those which he had now put forth, it should be remembered that that gentleman had in the first instance been led to publish his opinions without having had any actual practical experience of the system. This experience he had since had, and, as the meeting knew, it had proved unfortunate to him, inasmuch as he had been subjected to an action at law and other difficulties. He (Mr. Boulnois) therefore contended, that it was the duty of the patentees to ascertain and remove all such difficulties and defects as Mr. Christopher had met with in his practice, and not to allow the task to devolve on the architect employing their system of flooring.

Mr. H. H. Burnell, Associate, contended that the French system presented greater economy of space than the English, and that the latter was very defective in respect to its giving no key for the ceiling.

Mr. Barrett and Mr. Wyatt expressed a contrary opinion on the latter point.

Mr. Wyatt said he had no doubt that Mr. Christopher had written his pamphlet, "Notes of a Visit to Northwoods," with the most perfect conscientiousness, but after expressing himself so very strongly in favour of the system there used, and leading others to adopt it, he of all persons should have dealt as leniently as possible with any defects to which it might be liable. For himself he had found that the system fully justified the praise which Mr. Christopher *originally* bestowed upon it.

Mr. Christopher, Fellow, reminded the members that at the commencement of his former remarks he had stated that he thought very highly of Messrs. Fox and Barrett's system. He had made minute inquiries of Dr. Fox, of his architect, and of the workmen at "Northwoods," and was led to express his opinion very strongly in the pamphlet quoted by Mr. Wyatt; and he still thought that for all practical purposes, this system from its economy was superior to any other for fire proof construction. He was therefore gratified to find that Mr. Wyatt, after his extensive experience, did not think the warm approval which he (Mr. Christopher) had formerly expressed in any respect overcharged. On reading the remarks which he had made at the last meeting, he confessed they appeared rather strong, and he should be sorry if they were to injure the patentee. Still, however, after four or five years experience, he had found imperfections in the system which had occasioned him much annoyance and loss, and he felt bound to caution his professional brethren on the subject. These it was true were comparatively *little* defects, and he did not wish to magnify them. He was not desirous to retract any of his former remarks as he believed them to be strictly correct, with the exception of an obvious error of £1. for fillets to a boarded floor in the estimate for a room of 20 ft. × 20 ft. Mr. Beck, in reply to an appeal from Mr. Barrett, had stated that he did not think it necessary to make any addition to "the footings of the walls" for this system; but what he (Mr. Christopher) considered necessary was to increase the "foundations," a distinction recognized in the Building Act and by other authorities. It was essential to be very careful with the foundations where this system was employed, especially if a rigid material like Portland cement were to be used for the floors. Hoop-iron bonding he considered necessary, as in the patent system there was no provision for a tie, and no substitute for the timber plates used in ordinary construction. Again, the play of the iron joists before the concrete was filled in was objectionable, and liable to loosen the green brick work; and it had obliged him to take out the arches over openings and substitute stout iron lintels. He had not ventured to offer the remarks he had made in any case from the result of *one or two failures only*, and in all cases first rate builders had been employed by him, and no expense or pains had been spared. On the subject of cost he had confined himself to *Mr. Barrett's estimates*, published in the Transactions, and the question was, are those correct and not what the Wilts asylum may have cost some years ago, when

iron was at less than half its present price. With reference to the question of cost generally, he (Mr. Christopher) should not have entered upon the subject, if Mr. Barrett had not endeavoured to shew that his fire-proof floors could *now* be constructed cheaper than ordinary floors of the best kind. Mr. Barrett had made a deduction of *one half* the cost of the iron from his estimate for "excess of strength," and this deduction was one which he (Mr. Christopher) thought quite unwarranted; because if the strength of the floors were proportionably diminished, they would not be safe.

Mr. Wyatt. What Mr. Barrett said was that he would not like to take the responsibility of the lightness of the French mode of construction, but that a great reduction in his standard of strength might safely be made.

Mr. Christopher repeated that Mr. Barrett's estimates were incorrect; that when he went into the matter with that gentleman they had found it impossible to reduce the price to that of an ordinary timber floor, and that the additions made by him to Mr. Barrett's estimate for cutting and trimming joists, the use of the license, &c. were fair and moderate additions. Carefully detailed accounts had been kept of the recent buildings erected under his direction to test the result, and from these he had quoted, but Mr. Wyatt admitted he had not gone into the estimates. Another point that deserved consideration was that many persons would desire a wooden floor upon the concrete foundation; and in that case a considerable extra cost was incurred, and some of the advantages were lost, as the building was less fire-proof, the floor afforded a harbour for vermin, and was liable to rot, besides which there was a loss of space. With respect to the roofing it should be observed, that at Northwoods the concrete roofs were all finished with tarred paper and sand, which had been found successful. The Building Act however precluded the use of these materials in London, and therefore cement *alone* was used, which had failed, as before described. Now although this question had been discussed chiefly with reference to *floors*, it appeared to him that the *roof* was the most important consideration with respect to fire-proofing, as many buildings had been ignited through the roof from fires in adjacent buildings, and certainly if *floors* could be constructed on this principle at the same cost as ordinary floors, *roofs* could be constructed at less than half the ordinary cost.

Mr. Barrett wished first to offer a few remarks in reference to some observations made by Mr. Tite at a former meeting. That gentleman stated that the system of fire-proof construction, which Mr. Barrett had explained, was very similar to one which he (Mr. Tite) had himself used twenty-eight years ago. There were, however, important differences, both in the principle and the cost. In the plan referred to by Mr. Tite, the stone landings were merely a modification of the iron girder and brick arch system; they were a dead weight upon the girders, and not an element of strength; while in his own plan the union and combination of the different materials produced a great increase of strength and rigidity, and at a small expense. In the one case these important qualities were derived from the *iron*,—a costly material; and in the other from the *concrete*, a very inexpensive one. But the real question was, not whether any of these materials had been previously used in the construction of floors, it was rather whether they had been so arranged and combined as to produce a satisfactory floor of incombustible materials at a cost little, if at all exceeding, that of the ordinary timber construction; whether in fact it could be said before the introduction of this system (as it had been said by Mr. Wyatt) that a large and important public building had been constructed on a fire-proof principle without incurring one shilling additional expense. Reckoning the cost of the 4-inch and 6-inch self-faced stone landings, at prices furnished to him by a contractor, viz.— 1*s.* 6*d.* and 2*s.* per foot, and assuming the iron to be no heavier than in his own case, the actual cost would be more than double that of his construction; thus—

Room 12 × 12.

	£.	s.	d.
144 ft —4 in. Landing—at 1*s.* 6*d.*	10	16	0
Iron Work as at page 47	3	15	8
Facing Surface and forming Cement Ceiling, 6*d.* per ft.	3	12	0
	£18	3	8
Instead of	7	14	10
Difference	£10	8	10

Room 20 × 20.

	£.	s.	d.
400 ft.—6 in. Landing—at 2*s.*	40	0	0
Iron Work as at page 47	21	4	3
Facing Surface, &c., 6*d.* per ft	10	0	0
	£71	4	3
Instead of	32	4	3
Difference	£39	0	0

He thought, therefore, there was sufficient reason for such a system never having come into general use. Mr. Tite had also referred to the decoration of ceilings, but he could not imagine any difficulty whatever to exist on this head, and if none was found in erecting a residence for the highest personage in the realm, there was little probability of its occurring elsewhere. Certainly any kind of decoration that could be combined with the girder and arch system could, with at least equal facility, be applied to his construction: but upon this point any member present might satisfy himself by inspecting the New Offices and Station of the Brighton Railway Company at London Bridge, where the system was carried out on a very extensive scale, some of the bearings exceeding thirty-five feet, and where many of the ceilings were of a highly decorated character. Mr. Tite had also spoken of the possibility of the concrete yielding under the action of fire if it were formed with flints. This material was, however, never used for the purpose; the concrete being made of fine gravel or ballast, broken brick or tile, burnt earth, and lime. Upon this point he thought an important consideration had been overlooked, viz.—the fact that in warehouses where large fires occurred, they were mainly owing to the circumstance that the timber floors themselves afforded both the fuel and a ready supply of air to support and extend the fire, which would burn but slowly till it had consumed a portion of the floor, so as to obtain a supply of air. The case, however, was very different, if instead of a floor being of a highly inflammable nature, it was formed of a solid mass of incombustible materials twelve inches thick, by which the supply both of fuel and of air would be cut off. The fire, generating an atmosphere which will not support combustion, would under such circumstances probably burn itself out. Even supposing any intense degree of heat to be generated, before it could act injuriously on concrete it was probable that it would quite destroy a brick arch, either by disintegration or by the arch's own expansion; and the consequences which might result from the failure of a single arch in a building were fearfully exemplified in the fall of a cotton mill at Oldham some years ago, the replacing of one of the arches which had settled having led to the breaking of the iron beams from the lateral thrust of the adjoining arches, and the sudden and instantaneous destruction of the entire building—a calamity which could never possibly happen with his plan of construction.

With regard to the objections raised by Mr. Christopher at the last meeting, there could be no question that Portland cement should never have been applied as a finished covering for roofs, but that gentleman had not stated that he had himself preferred it and introduced it. Indeed he was the first to erect a roof upon the principle since the completion of the original building, the roofs of which he, "after careful inspection, "greatly admired, and described in 1848 as being "marvellously simple and inexpensive while efficacious, being perfectly water-proof, and much more impervious to the variations of temperature than the usual roofs;—those built eight years since being perfect, and the ceilings under them without a stain."

Mr. Christopher had adhered strictly to the construction of these roofs, except in that part which in his case had failed, viz., the finished covering, which he had formed of Portland cement, instead of tarred paper and sand, the use of which was said to be prohibited by the Metropolitan Buildings Act. It had been intimated by that gentleman, that the failure of the cement covering might have been occasioned by the expansion of the concrete; but the fact of its remaining sound for twelve months, shews that it could not have arisen from that cause. Concrete does unquestionably expand *in setting*, but not afterwards. Mr. Christopher had moreover told him, that the experience of a brother architect showed that when Portland cement was laid on brick arches, there was the same uncertainty as to the result. It was however, admitted, that metallic lava answered, and he might add, that asphalte, tiles in cement, and slates in cement, had also been applied with perfect success.

As a finished surface for floors, Portland cement had answered perfectly in several instances, but it was a very uncertain material, and in those cases where the floors were not to be carpeted or covered, or where a slight superficial defect was of consequence, it would be better to use a cement of another description, such as Keene's, which had been substituted for Portland in a large building lately erected by Mr. Clarke—the Metropolitan Convalescent Asylum—at an additional cost of only £30., and it certainly looked much better.

With reference to the ceilings, and the alleged want of a good key having occasioned several falls; Mr. Barrett first observed, that if this really were a radical defect in the system, it admitted of a very simple remedy, for nothing could be easier than to attach the ordinary lath and plaster ceiling by means of light fillets placed parallel with the joists. So far, however, from the key being defective, he had been assured by practical men, plasterers, and foremen, that the key was a much better one than in the ordinary construction, from the greater strength of the laths. He had communicated with several members of the profession who had used the system largely, upon this and other objections stated by Mr. Christopher; amongst them were Mr. Wyatt, who had had from 1,400 to 1,500 squares of flooring constructed; Mr. Rhode Hawkins, 530 squares; Mr. Brandon, 900 squares; Mr. Clarke, 400 squares; Mr. Salvin, 500 squares; Mr. Holland, 1,200 squares; and Mr. Piper, 1,400 squares; in the aggregate several thousand squares; and it was remarkable that out of so large a quantity no instance should have occurred of a ceiling falling. In Mr. Christopher's case, he believed it to have arisen from his having kept coke fires in the middle of the room, *upon the concrete, for several weeks in succession*, to dry the plastering of the walls; as the portion of ceiling which fell was directly under one of these fires. The report of a Committee of Magistrates who visited Northwoods to see the original building, was to this effect.

"Our attention was first directed to the very beautiful and perfect appearance of the ceilings of the rooms, (after fourteen years' duration), which are in fact a part of the fire-proof floor; these ceilings, even after so long a period, presented a perfectly plane and level surface, and were quite free from cracks;" and Mr. Christopher's own report of this building was "the ceilings are finished and appear as usual, but equalling the best, as they remain for fifteen years without a crack!" Mr. Christopher had also stated in reference to the ceilings of the building, the roof covering of which had failed, "the ceilings were everywhere entirely free from cracks, and decidedly more perfect than in ordinary buildings."

He begged permission to read the following letters from some of the gentlemen he had referred to.

From Mr. Joseph Clarke, Fellow:—

I feel I ought to add my testimony to what I consider the full success of your patent, which I have adopted in several important buildings for some years past. I must say that I have not met with a single failure, and certainly on the points of objection which I hear have been raised:—

1st. That the adoption of the system involves greater expense in Foundations. These I have never considered it necessary to increase in the least, in fact in one work I am now carrying out on your principle, I even reduced the depth, and on a site of which I had a little apprehension.

From the confidence I have in the perfectly horizontal bond and tie given to the Walls, I am satisfied that in the Oxford and the Gloucester and Bristol Training Institutions, (both stone buildings) I derived much greater advantage than if I had adopted the common mode of Timber floors.

2ndly. As regards a greater chance of smoky chimnies, I have been singularly fortunate in all the buildings thus constructed, and I can refer you to the Convalescent Hospital at Walton, where not a single chimney smokes out of nearly fifty, which have been in operation for months, even before the building was complete, that it might be ready for the patients.

As to the 3rd objection, that the ceilings are apt to fall, I have carefully examined many hundred squares, executed on your principle, and I do not find the slightest tendency of the kind.

I am so fully convinced of the value of your invention that I am prepared to recommend it, particularly since the adoption of wrought iron, for every class of building.

From Mr. Rhode Hawkins:—

There are three points on which you ask my opinion of the fire-proof floors used at the new buildings at Guy's Hospital.

1st. With regard to the necessity of using more solid foundations in consequence of the increased weight of the floors. I have to say that though your floors are heavy as compared with ordinary wood floors, yet as the weight of the floor is after all but a small portion of the whole weight which a foundation has to carry, I do not think that the extra weight should be considered for a moment; as to the necessity of additional ties to the walls, if the girders and joists are of sufficient strength, the weight will be conveyed directly on to the walls, and resolve itself into a mere crushing force, and ordinary brick walls are competent to carry five or ten times the weight which is generally put upon them. With regard to the ceilings, I have only to say that at Guy's Hospital I know of no ceiling having given way, the key seems to me to be a very strong one, and I see no reason to apprehend any accident of the sort. The ceilings have been finished nearly a year and a half, and are perfectly good now. With regard to the floors causing smoky chimnies I have little to say, as I have not tried the plan in an ordinary dwelling-house. At Guy's Hospital the smoke is carried in a long smoke tube into a lofty shaft where there is a considerable draught, and none of the chimnies smoke; but I must add, that I think that where it is necessary to supply air to the fire-places, it should be done as a system, and not left to the chances of drawing the air through the floors, and with it a large quantity of dust and dirt.

From Mr. R. W. Armstrong:—

In reply to your query whether I deemed it necessary to go to extra expense with the foundations of the buildings in which I introduced your patent fire-proof flooring, beyond that which I would have done had I used timber floors; I beg to say the buildings in which I used your system of flooring, being for factory purposes, I considered it expedient to provide foundations sufficient for any emergency, and therefore did not allow the fact of the floors being heavier than timber floors to influence me in any way. As to the broad question for buildings in general, much must depend on the number of floors and the proportion of bearing points to the void or area to be supported on those points, but I think few would venture to erect buildings with timber floors on foundations that would not be equal to the sustaining of the additional weight of floors constructed on your principle, as in

my opinion it would be narrowing the point far beyond the limits of practical application. I have not in any instance found it necessary to introduce any additional "*ties*" for the floors than that given by the joists.

From Mr. Thomas Piper,

The result of my experience with floors constructed on your principle, is that no additional foundations or ties are required beyond what would be requisite and necessary for good building on any principle. That the ceilings are not more liable to fall than ceilings on laths in the ordinary way, indeed I cannot charge my memory with any instance of a ceiling falling in any of the works carried out on your plan. As to smoky chimnies they are no novelty unhappily, and though the tendency of the greater accuracy of all building operations is unquestionably to limit the supply of air and so retard the escape of smoke, I have noticed no difference between what occurs with your floors and a thoroughly good wood floor of the ordinary construction pugged in the usual way.

Mr. Brandon states that "he has never had cause to increase the strength of foundations, or the walls, or ties in the walls. He has never known any defect whatever in the ceilings, except an occasional very minute crack, such as might be found in those of the ordinary construction, perhaps 10 or 12 such in a building, containing 800 squares, and he has never known an instance of chimnies smoking."

With regard to the time required for the floors to dry, it depended on the season, but they were always dry as soon as the walls and plastering made it safe or prudent to occupy the building; at some floors lately constructed at Windsor Castle, the rooms were occupied in six weeks from the receipt of the joists. The house in the Adelphi referred to by Mr. Christopher, was begun in April 1850, and though it was a large building containing nearly 30 rooms, and lying close to the river, it was occupied in March 1851, although there had been several delays. The peculiarities of the other building he referred to should have been stated: it was in a hollow, with lofty buildings at the back, two high flank walls, and a narrow mews in front; there was in fact no possibility of establishing a current of air through it, even if its construction had admitted; but the fact was, that out of 42 rooms, only 18 had fire-places, and the 24 rooms which were without fire-places were all so constructed that there could be no current of air through them, and 12 of them were lighted only from the staircase. These circumstances were quite sufficient to account for its taking a longer time than usual to dry.

With respect to ventilation and artificial warming, it was quite true that facilities were afforded by the system, if those adopting it would avail themselves of them; but that they were more *necessary* than in the common method was not the fact; and as regarded loss of draught to fires by the floors not affording a supply of air, it struck him that this was rather an advantage than otherwise, as cold draughts to the feet and legs were always objectionable; indeed Mr. Christopher himself had been one of the first to point out this as an advantage of the system. Certainly this had never been complained of by any one else, and numerous enquiries had satisfied him that the complaint had no real existence. In speaking of Northwoods, Mr. Christopher had stated that "regarded simply as a residence, it was most comfortable." And so satisfied were the Metropolitan Association for Improving the Dwellings of the Working Classes with this system of construction, in one of their buildings containing 186 rooms, that the Secretary had written as follows:—

From Mr. Gatliff, Secretary of the Metropolitan Association for Improving the Dwellings of the Industrious Classes.

"In reply to your inquiry as to the success of your fire-proof flooring in the 186 rooms in which it was used by the above Asssociation, I beg to say that an accident not having occurred to test its qualities in that particular, I cannot say more than that from the opinion I have formed, I should recommend its adoption in between 3 and 400 more rooms about to be constructed by this Association in Guy Street, in the Borough of Southwark, and more especially from its being *sound*-proof, which we find a great inconvenience from, in about the same number of rooms in the Old St. Pancras Road."

It was stated in the Ninth Report of the Directors of this Association, that in the family dwellings above referred to, providing accommodation for 60 families, not a single death had occurred in the course of the preceding year, out of an average population of 300; a circumstance which may be presumed to indicate that the system is not without its advantages as regards the health and comfort of the occupants: and besides the circumstance of the building being fire-proof, the Association has found that on certain other points this system of construction possesses advantages which are of much importance in buildings of this character, being "very instrumental in preventing the travelling of sound from floor to floor, of vermin, of offensive smells, and of the filtration of water in case of accident from the overflowing of cisterns or otherwise." These floors had a boarded finished surface.

These facts he thought rather indicated that the system was advantageous as regarded the health of the occupants of the buildings, and this could not be said of smoky and ill-ventilated dwellings.

The alleged necessity for better foundations and ties, was perhaps best met by the letters already quoted: they were not provided in the five-story building mentioned at the last meeting, nor at the large Hotel at Carlisle, lately erected by Mr. Salvin; and he referred particularly to these two works, because the plans of both were originally prepared for timber floors, and no alterations were made by the introduction of the fire proof system; nor could he find that they had been increased in any instance. In the original building at Northwoods, and many others, no ties whatever were provided.

As to the License, although the charge was rather for the information supplied, yet it could easily be shewn that it was soon repaid by the saving in the fire-insurance. This saving on the building in the Adelphi was £4. 10s. per annum, repaying the charge in less than seven years, and after that time becoming an annual saving to that extent in perpetuity.

The charge for cutting and trimming joists was certainly an error, as the castings were not adapted for trimming; the building had been altered during its progress, and some little expense might possibly have been incurred on that ground. The painting of the joists was by no means necessary.

Upon the question of cost, Mr. Christopher had stated that the estimates were not to be depended on, and he had given a calculation of his own, making additions, to every one of which he, Mr. Barrett, altogether demurred, and for which he had shewn there was no foundation, as they had not been incurred by any other architects. The figures he had originally given in page 46, spoke for themselves, and showed the cost with the iron of the strength he usually employed, and also of that used in Paris. He did not however recommend a reduction to their standard, but had stated that some reduction might very safely be made, and he had actually had floors constructed with joists 25 per cent less in strength than those which formed the basis of his calculations, and with perfectly satisfactory results. He had no doubt whatever that the joists he used were much in excess in point of strength, and he was confirmed in this view by the fact that those of extra strength described in Mr. Burnell's table as employed at the Louvre (see page 54) were not so strong as those he had employed

for ordinary dwelling-houses. Mr. Christopher's conclusions were therefore altogether erroneous as to the possibility of reducing the strength, and the cost of the iron work fixed, Mr. Barrett had actually reckoned at 10s. per ton more than the price at which it had been lately undertaken. The cost of the roof, the cement covering of which had failed, was according to Mr. Christopher's own statements as follows:—

"The roof with ceilings and cement surface had cost £74; While an ordinary slated roof with ceiling, would have cost £232; and a lead roof would have cost £300". If the cost of an additional covering of metallic lava £40 were added to the cost of the roof with a cement surface £74, the total cost would be £114, against £232, shewing a saving of £118 or £3 per square on the quantity of flooring in the building.

Mr. Christopher had stated that the object of this discussion was to ascertain the truth, but this could only be done by the *whole* truth being stated, and that Mr. Barrett must contend had not been done in the several objections he had raised.

Mr. Scoles, Hon. Sec. inquired whether concrete had been really found to be fire-proof, and stated that a large mass which he had put into an ordinary fire had crumbled entirely in less than five minutes.

Mr. Barrett argued that this was not a conclusive test, indeed the plaster slabs mentioned by Mr. Wyatt at a previous meeting would have been destroyed under similar circumstances. It was in evidence that his concrete floors would be protected by the plaster ceiling, and where injury had arisen it was only by the long continued action of fires made for drying the plastering of the walls.

Mr. Papworth observed that in his opinion no really fire-proof floor or roof had yet been mentioned. An Obelisk erected in 1776 on Putney Heath, by order of the Corporation of London, commemorated the satisfaction felt by committees of that body with experiments made in 1776, described in a pamphlet, printed in 1785, and entitled "an account of the invention and use of fire-plates for the security of buildings and ships against fire." The author, Mr. David Hartley, was Member of Parliament for Hull. A reprint with additions by his nephew in 1834, stated that "resistance to every possible degree of fire, such as in distillers' shops, or turpentine warehouses, may be accomplished by applying the fireplates above and below the timbers with dry sand or rubbish between them: in experiments repeatedly tried with this double application, the room was filled from the floor to the ceiling with faggots and pitch and tar. As to common dwelling houses; when the single application of the fireplates was used in the experimental house, where also air bricks were provided to the floors, the trials were continued from day to day to the same part of the ceiling and timbers of the house a great number of times after the plasterwork was burnt down and destroyed, but the timbers could never be set fire to, so as to burn of themselves, nor could the fire ever spread sideways; as long as the burning faggots were applied to the timbers, they were charred perhaps to the depth of an inch of their substance; but the fireplates over them acted as an unconquerable extinguisher, preventing them from taking fire and burning of themselves." Rolled copper-plates are specified as well as those of painted iron; tinned or galvanized iron or zinc would be equally applicable. In 1774, the sum of £2500 was voted to the inventor by the House of Commons, and in 1777, the patent was extended for thirty-one years from that time. The experiments he made however shewed that the only way to check a fire was to prevent the access of air; for flame would inevitably calcine such materials as concrete and plaster. The various systems of iron flooring which had been discussed were valuable as precautionary measures, and worthy of attention, and Mr. Papworth had, therefore, much pleasure in moving the thanks of the meeting to Mr. Burnell and Mr. Barrett for their communications.

Mr. H. H. Burnell explained, that although violent and long continued heat would destroy the French floors, yet the earthenware pots would be a great impediment to the spread of any moderate fire.

Mr. Tarring, Fellow said, that in the West of England where concrete or lime ash floors were much used in common houses, the concrete failed or became rotten in the parts nearest to the fire-place, but when formed of lime mixed with sand and hair, it would last longer in that position than when composed of gravel. Plaster ceilings would resist fire, but cement would not, as that material soon yielded to heat. In old malt houses in the West of England, with concrete floors 5 to 6 inches in thickness, he had seen the walls though built of stone 2 ft. 6 in. to 3 feet thick, bulged out three to four inches on each side by the expansion of the concrete.

The Chairman reminded the meeting of the different effect which fire would produce on timber and on metal, from the former being a nonconductor and the latter a conductor of heat. Such effect should be guarded against in a fire-proof construction, so that the metal might not conduct the heat to the wood. Experience had shewn that in the event of a fire breaking out, the grand object was to get it under within the first quarter of an hour, and to aid in accomplishing this, the Building Act had wisely restricted the cubical contents of each division to be separated by walls in warehouses and similar buildings.

At the suggestion of the Chairman, the vote of thanks was extended to all the Foreign and English gentlemen who had furnished remarks upon the subject, and the meeting then adjourned.

Note.—Mr. Christopher thinks that the apparent difference in the testimony borne by Mr. Wyatt and by himself in reference to Fox and Barrett's patent may probably be explained by the fact that Mr. Christopher's experience has been almost wholly confined to London, while Mr. Wyatt's appears to have been restricted to the country. In London the frequently disturbed state of the soil and the height of the buildings require *extra foundations*, while the numerous windows, confined to the backs and fronts with small piers of separation, and many difficulties of construction, demand *extra iron* bonds. The long unpierced party walls, the contracted areas at the backs of the houses, and the want of sun in front, retard the drying, while the same causes, coupled with the smallness of the rooms in chambers and dwelling-houses, compared with the large dormitories and corridors in Asylums will, in some measure, explain why the loss of draught to the fires from the absence of hollow floors and partitions is so felt in these solid houses. Mr. Christopher thinks that none of these difficulties would occur at Northwoods, situated in the midst of a park, or to the buildings which Mr. Wyatt, Mr. Clark and others, have superintended in the country. Mr. Christopher wishes to state that neither pains nor expense were spared to secure the most perfect execution of the buildings carried up under his superintendence in respect to materials and workmanship.

A BRIEF ACCOUNT OF THE PALACES OF THE LOUVRE AND TUILERIES, PARIS, FROM THEIR FIRST ERECTION TO THE PRESENT TIME; WITH A GENERAL DESCRIPTION OF VARIOUS PROJECTS FOR THEIR COMPLETION AND JUNCTION, PARTICULARLY THE ONE ACCORDING TO THE DESIGNS OF THE LATE MONSIEUR VISCONTI, HONORARY AND CORRESPONDING MEMBER, NOW IN COURSE OF ERECTION.

By T. L. Donaldson, Honorary Secretary for Foreign Correspondence.

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First Epoch, or The Feudal.

A Map, supposed to be of the period of Dagobert the 1st., the authenticity of which, however, is much contested, would lead to the supposition, that the Louvre already existed as a hunting palace at that time—that is, A.D. 633. But the first precise mention of the Louvre would appear to be under Louis le Gros, 1108, who received the oaths of fidelity to him at the Louvre, at that time regarded as an important fortress. It was placed just outside the town, on the bank of the Seine, where its position commanded the approach to Paris on this side, and defended the city from the attacks on this quarter, the main road passing inside its exterior defences.

Philip Augustus (1180-1223) rebuilt and made considerable additions to it. He constructed the great Donjon tower in the centre, as a state prison, and for the safety of his treasure, 96 ft. high and 48 ft. in diameter, the walls being 13 ft. thick at bottom and 12 ft. at top, and surrounded by a ditch.

Charles V. (1370-80) was the first king after Philip Augustus, who embellished the Louvre, hitherto more distinguished as a strong fortress than a kingly residence attractive by the graces of art and embellishments of taste. The reign of this king was most favourable for architecture and sculpture, as he was fond of the magnificence of the kingly state, and loved the arts as adding to its value and conferring true beauty. He enlarged and adorned many royal residences, and erected many castles, as those of Creil and of the Bastille. He added considerably to Vincennes. Mons. De Clarac gives a plan of the chateau of the Louvre, founded on the works of Sauval, who wrote at the time of Louis XIV, and whose book is intitled "Œuvres Royales;" and although Sauval has no plan, he is so minutely particularly in his description of each portion of the castle and dependencies as to afford authority for every part. The enclosure of the Louvre, comprehending the fosses, but exclusive of the outer works, was nearly square, measuring 360 ft. towards the river, and 342 ft. in the other direction. At the angle of the outworks next Paris, and close to the Seine, there was a lofty tower, opposite to a corresponding one, the Tour de Nesle, on the other side of the river, and which forms a prominent object in the old prints of Paris by Silvestre and others, a line of wall fortified by towers afforded security from attack on the side next the river, and formed an enclosed space outside the chateau. This angle tower was possibly the Tour de Vindal of those times, and, as a leading position, probably had under it the sluice gates, which regulated the quantity of water in the fosses secure from any attack, which might leave the ditches dry. Attached to it was the Gate of Paris, flanked by circular towers, and a corresponding one, the Porte Neuve, was at the other end of the court.

Near the Gate of Paris is an entrance into one of the "bassecours" of the chateau, leading to the gate of the tête du pont, close to the central towers of the façade facing the river. Here, also, was an entrance to the gardens laid out in beds, with a trellis at the further end, and immediately in connexion

with the dependencies. It will be remarked that this gate at the tête du pont has a lateral entrance, not immediately fronting the entrance towers of the castle, a precaution observable in other castles, as affording greater security to the approaches.

The fosses were not all of equal width, varying from 32 ft. to 48 ft. wide, and about 20 ft. deep. On the side next Paris were the offices of the chateau outside the fosse, and containing those dependencies required for the service of the Royal Family. Towards the north and outside the fosse was the "*grand jardin*," or grand park, and, being outside the city, it produced abundance of vegetables, fruits, and flowers. On the west side, and near its south-west angle, was the arsenal of the artillery establishment, with courts and buildings necessary for all the works, as the foundry, stores, and workshops, &c. connected with that arm of military warfare; and attached to it was an ample residence and garden for the master of the artillery.

Near the street of the Froidmanteau there was, ever since 1333, the menagerie, a usual appendage to royal residences of that period, and which also remained in the Tower of London up to within our own time. Here were kept rare animals, brought at a great expence from foreign lands, which served as a curious show, and sometimes afforded sport by being made to fight each other. Charles V. had one in his Hotel de S. Paul, a record of which is retained in the name of a street, Rue des Lions, which was carried through the spot formerly occupied by the menageries: so frequent is it that names of streets hand down traditionally the former purposes for which certain sites once served. Having thus generally noticed the arrangements connected with the fortifications and the domestic arrangements of the basse cour, gardens, and arsenal, &c., we shall proceed to examine the body of the castle itself.

The central court was about 206 ft. $\times$ 197 ft. square, entirely surrounded by buildings, with the central Donjon in the middle. Raimond du Temple was the master of the works, or architect to Charles V., and executed the various additions and alterations which were made at this time, not only to the chateau of the Louvre, but also to that of Vincennes. The several towers had each a specific name, particularly those at the angles, which were called respectively next S. Nicholas, next the Seine, next the great garden, according to their position, and are represented in various views of remote periods as still existing, as in those of Quesnel, Sylvestre, &c., in various manuscripts as late as the 16th century.

Each entrance was flanked by two towers, but that towards the Seine being the principal one, was strengthened by being of larger dimensions. Over the centre was apparently the clock tower; probably the clock was placed there by Charles V. about 1370, when public clocks were first generally introduced in Paris, for doubtless that enlightened prince, the first to patronize any novel invention, had one placed at the Palace by Henri de Vie.

On the west side there would appear to have been an entrance equally important with that next the river, flanked by two towers, with a drawbridge and two turrets, forming, as it were, a tête du pont; and there is an ample open court or space outside the precincts of the castle, next the Rue Froidmanteau, affording access to the artillery arsenal, and the menagerie already mentioned.

On the north side there was only a secondary class of exit for the purpose of reaching the great garden over a light bridge.

On the east side is a central secondary entrance, flanked on the outside, and leading by a drawbridge to the domestic offices, an arrangement apparently founded on the authority of Sauval's description.

The central Donjon Tower communicates with the buildings, which surround the court by a bridge and a narrow gallery leading to a grand circular staircase (la grande vis), affording access to the upper floors. It was in a circular tower, 61½ ft. high, with a terrace on the top. This staircase

which existed up to the time of Louis XIII., is mentioned by Sauval as having been a chef d'œuvre of Raimond du Temple, the architect and sculptor, both in point of construction and decoration. There were ten large statues on pedestals; the mouldings were richly carved.

We will now consider the arrangement of the apartments, on the authority of Sauval, who appears, according to the registry of the "Œuvres Royaux," to have followed the order of the several rooms and halls. The apartments of reception and ceremony were on the west side, the apartments of the King and Queen to the south, next the river. Those of the Queen on the east side of the principal entrance consisted of two large chambers, cabinets, and garderobes, an oratory, and bath. On the western side of the entrance was a noble hall, called "Salle Neuve de la Reine," 54 ft. long × 27 wide; and at one end of it the tower of the Library, to which there was access by a small circular staircase in the thickness of the wall from a vestibule opening immediately into the court. Although dignified with the name of Library, the apartment destined to receive books was not necessarily large in extent; for, before the invention of printing, as all books were, of course, in manuscript, the amplest fortune could not boast a very numerous collection, frequently more used by the chaplain than the owner. It is a question whether Charles V., on the death of his father, John, had ten or twenty volumes. About one hundred years before printing was discovered, nine hundred volumes was a very considerable number. Charles V. had collected them from all countries; he sought those most beautifully written and emblazoned, and had them richly bound, and he allowed any one the privilege to consult them who was distinguished by his learning, or known to be studious; and for this purpose the library was open by day, and in the evening. It is a curious circumstance, that forty-nine years after the death of Charles V.—that is, in 1429—the Duke of Bedford, then Regent of the kingdom, purchased the collection of works, then only 853 in number, which were sold for £2,323. of our present money, and sent over to England.*

It may be well imagined that this Royal residence was embellished with becoming decorations, and that the furniture, fittings-up, and other accompaniments were of corresponding beauty and magnificence. But after the time of Charles V. (1380) it was much neglected; Charles VI. only added to the fortifications, and the immediately succeeding monarchs no longer occupied it as their residence.

Second Epoch, or The Renaissance.

We now enter upon the second epoch in the history of the Louvre, which had hitherto served as a fortress and a castle.

About 140 years after the death of Charles V. François I. mounted the throne; he was a monarch, who deeply felt the charms of art, appreciated their value, and by his enlightened taste created a school, which has held ever since a first rank in Europe. He turned his attention to the embellishment of Paris, and while the Popes and Medeci were promoting the fine arts in Italy, he encouraged them in France, and by his favour and liberality attracted the Italian artists to France, where they found an honourable reception.

François I. perceived at once the vast changes, which the feudal Castle of the Louvre required in order to make it accord with the wants of a more refined age. He resolved to destroy the greater portion, and to rebuild it on a new plan. In fact, it is generally more easy and judicious, and often also less expensive, to construct an edifice altogether anew rather than to make ancient constructions accord with new arrangements.

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* On this matter I am kindly referred by Sir Henry Ellis to the following work—Bibliotheque Protypographique ou Libraries des fils du Roi Jean, Charles V, Jean de Barri, Philippe de Bourgogne, et les siens. De l'Imprimerie de Crapelet 4to. Paris, 1830. The name of J. Barrois is attached to the Preface.

D'Argenville is of opinion that the new works were commenced about 1540; and it is supposed that Pierre Lescot, then about 30 years old, had charge of the project. But during the reign of that monarch, it would seem, that the operations rather consisted in pulling down the old building, and in arranging a noble hall in it, since known, from its decoration, as the Salle des Caryatides. Lescot continued his operations under Henri II., François II., Charles IX., and Henri III., and called in aid the rare talents of Jean Goujon and Paul Ponce to execute the sculptures. Whether François I. contemplated the great enlargement, which the Louvre subequently received, cannot be ascertained, as the plans of the architect have not been preserved, and Lescot only operated upon the south and west sides of the old chateau, which were only half as long as they are at present. He gave the elevations the renaissance character of decoration, converting the circular angle towers into simple flat projections. He was influenced by the feelings which directed the architects of the mediæval period. The outside of their chateaux and palaces were simple and severe, defying attack; but they rendered their interior courts more rich in ornamental detail, as being secure from danger; the windows were more spacious as offering no facilities to any enemy in that position, and they sought to give a more cheerful character, where the sombre appearance of the building would have offered no advantages. So Lescot made his exterior plain in feature, but the interior of the court revels in excess of ornament, profusely lavished. Columns and pilasters, richly carved cornices, pediments, imposts and panels, statues, bas reliefs and sculptures throughout, produce a dazzling brilliancy, which bewilders the attention and evinces a great want of repose. But Lescot was a great master in his art, and for his noble conceptions was made Canon of the Cathedral of Paris and Abbot of Clagny near Versailles, thus uniting the crozier to the T square. Serlio, who was in France at this period, is supposed to have been occupied upon the Louvre, and to have made a design for it; but Lescot's was preferred, even, it is said, with the concurrence of the frank Italian, who acknowledged, as it is affirmed, the superiority of his rival's design. Serlio died in 1552, passing the latter years of his life at Lyons and Fontainebleau, highly respected for his talent, but tormented by the gout and miserably poor. Parts of the chateau of Fontainebleau are attributed to him.

Catherine de Medici, widow of Henri, undertook a work about 1564, which hereafter much influenced all operations connected with the Louvre, and of which it was henceforth to form an integral part. This Queen determined to erect a country palace just outside of Paris, but not too remote from the Louvre, in a plain where there were certain tile kilns, and which gave the name to this palace of the kings and emperors of France—I mean the Tuileries. She called in the taste and skill of Philibert de l'Orme, already advantageously known under Francois I. for works at Fontainebleau, Meudon, Villers Cotterets, in the tombs of the Vallois, and for the charming gem, the chateau d'Anet, which he built for Diane de Poictiers. He associated with him Jean Bullant, a man of no mean reputation, and they together designed a magnificent project, of which they executed only a fragment, as it were, such as the banqueting house of Whitehall is to the grandiose project for the Palace of Charles I., as fully designed by Inigo Jones.

The complete plan for the Palace of the Tuileries of Catherine de Medici consisted of a parralellogram 895 ft. × 555 ft., with three courts, the central one being much larger than the others, as according to the plan in Ducenean and Durand's paralel it measures 377 ft. × 295 ft., the two smaller ones each as long as the large court though less wide. The rooms and galleries appear to be from (10 m. to 12 m.) 33 ft. to 40 ft. wide, and some of the galleries 426 ft. long × 36 ft. wide, with noble staircases, chapels and other palatial arrangements on the most magnificent scale. One front only, however, was executed of this stupendous project, the rest, had it been carried into effect, would have occupied a considerable portion, at least one-third, of the present court of the Carousel. This gigantic

conception, even in its reduced part, was incomplete when Delorme died, in 1570, and never inhabited by the Dowager Queen, whose capricious taste was taken up with the erection of another palace upon the site of the present "Halle au bled," first called the Hotel de la Reine and afterwards the Hotel de Poisson, the expense of which absorbed the funds intended for the Tuileries.

It was during the progress of these works that an addition was made to the Louvre, by bringing out from its S. W. angle the gallery which runs down towards the Seine. It was only one story high, covered by a terrace, like the projecting wings of the Palazzo Pitti, of Florence, which possibly gave rise to the idea in the mind of the Queen, a Florentine by birth.

At this period then the Louvre and Tuileries present the following aspect. We find the W. and S. sides of the chateau as they were modernised by Lescot, under François I. and Henry II.; but the other sides of the chateau presented still the aspect of a fortress or prison, although many of its towers had been taken down. The projecting gallery struck out from the S. W. corner towards the Seine, and some imagine that possibly it was continued for a certain length along the side of the river. In the distance was the fragment of the Tuileries contemplated by Catherine de Medici, and partly erected by Philibert De Lorme and Jean Bullant. Such was the state of these two palaces, when Henry IV. mounted the throne; and as soon as he was at leisure, he determined energetically to embellish that Paris, which he had purchased at the sacrifice of his religion. He carried out the works, that united the two palaces by continuing the gallery along the bank of the Seine, and prolonging that end of the Tuileries. He added an upper story to the projecting wing of the Louvre, at the S. W. corner, upon which works Du Cerçeau was first employed, until he left France in 1598. Du Cerçeau was succeeded by Du Perac, and after him in 1602 Métézeau took part in these operations. Henry IV. also completed the Pont Neuf and the Hotel de Ville. It is also worthy of incidental notice, that Cosmo II, Grand Duke of Tuscany, from the affection he bore to Henry IV, who had married Marie de Medicis, after his death sent an equestrian statue to Paris, when Louis XIII. ascended the throne, and this was the first monument of the sort put up at Paris in memory of the French monarchs.

It was under the son of Henri IV. that the Louvre first commenced its development upon its present large scale. During the able ministry of Richelieu its present extent was contemplated, which rendered its court four times the size of its original dimension. Le Mercier was employed as the architect, and he extended the two sides already altered and faced by Pierre Lescot, and completed the square by adding the two other long sides; the principal entrance was under the Central Pavilion, next the Tuileries. This however he rendered overpoweringly lofty by adding an attic with colossal caryatides, which crush by their gigantic proportions the details of the lower stories. Le Mercier only executed the entrance story of these new parts, and pulled down the Northern and Eastern sides of the old chateau. The grand entrance in the centre of the North side is enriched with coupled Ionic columns, the idea of the whole arrangement being supposed by Argenville to have been inspired by the entrance vestibule of the Farnese Palace, at Rome, and somewhat similar to the more recent noble entrance vestibule of our Somerset House, by Sir W. Chambers, which it might perhaps have suggested.

In 1660, that is after thirty-six years' service in works of the highest order, carried out with the greatest talent, Le Mercier died wretchedly poor like his predecessor Serlio. At this time Louis XIV. reigned, and Le Vau was directed to continue the works at the Louvre, and he carried them on with an activity which was peculiarly his characteristic. He also extended Northwards the Palace of the Tuileries, so as to correspond with and equal in length the South end, already erected by Henri IV. But in 1664, the great Colbert being minister, a man of enlarged ideas and noble conceptions, found

that the style of Le Vau was not sufficiently dignified, and did not correspond with the magnificence, which should distinguish a royal palace. Although immense sums had been expended by Le Vau, he determined at once to stop the works and reconsider the design, which had been too hastily adopted, convinced that posterity did not at all consider the cost of a building, if its beauty answered expectation, whereas no consideration of economy ever reconciles after ages to an unsightly inappropriate edifice.

Third Epoch, or The Extension.

Colbert consequently determined to throw open the whole matter to public competition, and the architects of Paris were invited to send in designs. It appeared, however, that although the professional brethren of Le Vau had been willing and ready to prove, by very sound arguments and criticisms, the defects of Le Vau's design, they were incompetent to conceive others of superior merit, and they were rejected. But there was an eminent physician, a mere amateur of art, who submitted a project, which, novel in idea, bold in conception and dignified in character, seemed to equal the expectations of the magnificent Louis XIV. and his minister. Claude Perrault, supported by the personal influence of his brother Charles, who was Secretary to Colbert, was fortunate enough to have his plan regarded with great favour, particularly as Le Vau's, which had been sent to Rome to Nicolas Poussin to submit to the judgment of the architects there, had been generally condemned. Then the artists of Italy were invited to submit designs for the completion of the Louvre; and although numerous projects were sent in, still it appeared that the Italian artists, yielding to too lively and irregulated a fancy, did not limit themselves to practical ideas, but gave themselves up to fantastic notions, which did not fulfil any of the conditions and restrictions required by the actual state of the building.

Louis XIV. and his advisers, disappointed at this result, and distrusting their own judgment as to the design of their own countryman Perrault, a physician, and not an architect by profession, were anxious to try whether the palace of the capital of France might not find its architect, worthy of its high importance, in the illustrious genius of Rome, who had added so much magnificence to S. Peter's by the enchanting porticoes of its fore-court, and had embellished Rome and other parts of Italy by conceptions of the highest class. Rome was essentially the republic of the fine arts in all periods. Sculptor, decorator, painter, or what not, every one conceived himself capable of being an architect; and Rome owes some of its most remarkable, though, perhaps, not its most beautiful monuments, to men who, without going through the preparatory ordeal of professional study and apprenticeship, had the courage—perhaps I should say temerity—to think themselves competent, prepared designs, and, by favour, were appointed to execute them.

Bernini, then in the ascendant, had certainly, by his colonade of St. Peter's, the Baldachino, and staircase of the Vatican, and the Church of l'Arricia, proved that he combined fancy with judgment, skill, and taste, to a very eminent degree. His reputation dazzled the French King; and Bernini was invited to come to Paris to see the Louvre, and prepare a design. The cavaliere anticipated a Cæsar's victory, and the "veni, vidi, vici," result of the Great Roman. His journey to Paris was a triumphal progress. Deputations went out to meet him with speeches and memorials, as he approached the principal cities of Italy and France. When he neared Paris, an officer of the Court offered him the greetings of the "Grand Monarque," and a royal equipage and princely retinue conducted the no less illustrious artist to the anticipated scene of his future triumphal glory, where a noble mansion and munificent allowances awaited him and his assistants. But although caressed by the king and Colbert and the courtiers around the royal presence, the noble minded Bernini found that there were attacks

which genius, generosity, and frankness could not resist. The men he was brought to supplant called in question his talent, caricatured and maligned his intentions, defamed his works; a tide of defamation set in upon him. Under such unexpected malignant persecution, his imagination left him; he made a design, given in Durand's Parallel, which too much ignored all that had been done before. Although remarkable for simplicity, and nobleness of plan, and breadth of effect in the elevations, it certainly did not answer the expectation formed, and he soon left Paris disappointed, yet not without munificent tokens of the regard and esteem of Louis XIV. and his courtiers, who admired his brilliant talents, and respected his fine personal character.

Perrault then resumed the place, which his previous success had gained him. His plans were adopted, and on the 17th October, 1665, Louis XIV. laid the first stone with great ceremony; and so great had become the impatience to which all the above-mentioned obstacles had given rise, that the works were commenced, and carried on with such order, that the new façade with the colonnade was completed in five years. It would seem that Perrault had adhered to the plan originally laid out by Le Mesurier and carried on by Le Vau, and had merely increased the depth of the mass of buildings on the south and east sides of the Court. I shall not stop to describe the features of Perrault's design, so well known to those, who have visited Paris and admired the noble colonnade of the Louvre. I shall only allude to one remarkable evidence of the character of the execution. The two inclined cornices of the central pediment consists each of a single block of stone, 54 French ft. long, 8 ft. broad, and 18 in. deep. Practical men will understand the difficulty of raising such colossal masses 100 ft. high and setting them in their place; and it is but just to bear this testimony to the architects of this period, that the constructions executed for Louis XIV., though carried on with extreme haste, are of the most solid, durable, and substantial nature: they were composed of the best materials, set out with all the most intricate skill of their celebrated science of the "coupe des Pierres." I inspected a portion of the grand flight of steps of the terraces of Versailles with my friend Mons. Nepveu, under whose direction that palace, during the reign of Louis Philippe, underwent considerable alterations and received extensive additions. That gentleman pointed out to me the extreme care, regardless of expense, with which the constructions generally of Louis XIV. were executed, and he assured me that the whole palace was carried out with the like scientific skill and attention.

The Louvre, by 1671, received its external coating of the colonnade, and had had £380,000 expended upon this new part, without receiving any of the internal fittings; in fact, we may consider that Perrault had laid out an amount equal to £800,000 of our time, on the mere carcase, as it were, of his operations during these eight years. But a new fancy, and that one no trifling project, had been begun about the same time as the Louvre—I mean the new Palace of Versailles, where Louis XIV. wished to create a new city and palace for the residence of himself and courtiers, in the midst of a sandy barren desert. In twenty-seven years Versailles absorbed £3,246,000. money of that period, which we may consider equal to seven millions of the present time. About £900,000 of our money were expended in the year 1686 alone. This new project cast into the shade the old Louvre of his ancestors, and as the purse, even of Louis XIV., could not bear the continued drain of two such palaces, the Louvre was left unfinished as it was, little more than a bare carcase.

This state of neglect continued for 70 or 80 years, until the middle of the last century, when the Louvre, instead of being a complete palace, with its internal fittings duly in order and a degree of arrangement prevailing, was but a mass of incoherent divisions, appropriated to various incongruous uses; devoid of the finishings usual even in ordinary dwellings, many of the windows unglazed, nay, unsashed; in parts without roof; portions occupied as warehouses and stables, or used for ateliers by

painters, sculptors, modellers, and various trades, and even for baser purposes. In some parts on the north side private dwellings were attached to the very walls. Monsieur de Marigny, superintendant of the royal buildings, remedied many of the gross abuses to which the Louvre had been subjected. Mons. Gabriel, the most celebrated architect of that period, and who erected the elegant "garde meuble" in the "Place de la Concorde," was charged with the completion of the façades and other works, which he carried on with great zeal and taste; and after his death Soufflot continued the operation. But the usual fate of this unfortunate palace never abandoned it; and after a few years the energy of reparation and completion relaxed, and this noble building, which, during the 120 years of the joint reigns of Louis XIV. and XV., had been begun, left off, and resumed, abandoned again and again, was still, when Louis XVI. mounted the throne, an incomplete palace, and almost as uninhabitable as when M. de Marigny commenced the Herculean task of cleaning out the Augean stable. The sad misfortunes of Louis XVI. and the horrors of the French Revolution supervened, put a stop to all public works, whether useful or ornamental, and matters resumed their usual state of chaotic disorder, leaving the occupation of its corridors, halls, and chambers to the chance of the most violent, daring, and ungovernable "sans culotte," who claimed a portion for his right, as a citizen privilege of "first come first served." It was as a town taken by storm.

Fourth Epoch, or The Imperial.

At length Napoleon Bonaparte was declared Emperor in 1804, the star of the conqueror revived the past glories of the Tuileries and the Louvre, and a new era opened upon these palaces. The most valued spoils of his Italian victories consisted in the treasures of art, which he directed to be transported to Paris; but where were they to be placed? The vast scale of accommodation, which the Louvre offered, proved to be peculiarly adapted for the purpose, and M. Raimond, architect, was directed to prepare the halls and chambers to receive the new acquisitions—a vast and difficult operation, which he carried on with much ability and rapidity until his death in 1805. He was succeeded by Messrs. Percier and Fontaine, who had to reconcile the various incoherent parts, which existed in the elevations of the different sides of the court—to add in one part and to suppress in another; and they, with consummate skill, at length completed the court in about 24 years time, giving it that harmonious ensemble, which it at present offers, and which seems to be the result,—not of several ages each with its peculiar style,—not of numerous architects with different views and various tastes—but almost as though it were of one period and of one master mind. Thus the completion of the Louvre, both with regard to its structure and decoration, was accomplished within the first thirty years of the present century. It is not my intention to enter upon a critical review of the discrepances of style, arrangement, or taste in the various parts of the Louvre. It appears rather a matter of congratulation than of criticism, when we consider that, amidst all the fatalities of its career, it should have escaped a total shipwreck; and that the noble mindedness of great men of state, and the exquisite skill of her architects, and their respect for the labours of their predecessors, should, under such obstacles, at length have preserved and handed down to us a monument of the very highest class of art. The Louvre forms a precious historical page in the annals of architecture, tracing with little interruption the various modifications of taste during three centuries. The exterior façades and the internal elevations are in themselves harmonious, though discordant from each other, and yet not offering so strong a contrast as to shock one's prepossessions; and, in fact, they nowhere evince deficiency of study, nor an absence of the very highest qualities of artistic merit, whether in the conception or execution.

Fifth Epoch, or The Completion.

We will now turn to contemplate the great architectural fact of the present day, the completion of the Louvre and Tuileries, by their combination in every part, so as to form a congruous whole. Perrault had originally designed a project for this purpose, but here the deficiency of his ability as an architect made itself apparent. If executed, the addition would have thrown into the shade the Tuileries and the Louvre. He encumbered the intermediate space with 20 courts or vacant "places," square, oblong, octagonal, round, and cliptic; he surrounded them with edifices of all sizes, and of as varied forms. He lost all the breadth, of which the area admitted, and destroyed the dignity of ample space. The able Desgodetz vindicated his profession, towards the end of the 17th century, by a more noble arrangement, simple, and well understood; and, by a judicious disposition of certain masses of buildings, he masqued the differences of levels and lines, which existed between the two palaces.

The Emperor Napoleon entertained the idea of uniting the two palaces, but the practicability seemed beyond realization; for there existed an entire quarter of the town between the two, consisting of churches, palaces, streets, public institutions, and private houses, the mere purchase of which, and compensation for the trades and privileges of the inhabitants, seemed likely to absorb a considerable portion of a whole year's income of the Empire. However, numerous projects had been prepared from 1800 to 1812, and the illustrations before you present about 20 designs, from the hands of some of the most distinguished architects of the day. That of Messrs. Percier and Fontaine was approved by the government, and in consequence the north side of the Carrousel was, in 1811, begun to be enclosed for the length of about 700 ft., by a building corresponding with the Gallery of Henri IV. on the south side. The Triumphal Arch of the Carrousel from their design had already been erected. The first stone was laid in 1806, and the cost, which amounted to £40,000, was paid by funds derived from the conquest of Holland. Thus did the conquered provinces of France provide the means for the memorials of their own subjugation.

It is obvious, from an inspection of the plans, that one great difficulty, in the geometrical disposition for the union of the two palaces, consisted in the want of verticalism and parallelism between the block of the Louvre, the long wing that united the palaces, and the extended front of the Tuileries. To reconcile these differences and produce symmetry of effect was the great stumbling-block of all parties, who, forgetting how ill able the eye is to detect slight differences in execution, and small divergencies of parallelism in distant masses of building, sought to reconcile these incongruities by intermediate masses, and expedients of circular ends to the court, or by subdivision and diminution of the "Place du Carrousel," sacrificing the noble character produced by vast space, and limiting the "*Colpo d'Occhio.*" It was apparent, also, to some, that the Tuileries was deficient in domestic offices, residences for the household officers and persons attached to the Court, and particularly in residential accommodation for the immediate family of the Sovereign, the grand suites of saloons and apartments for Court ceremonials absorbing almost entirely the rooms required for domestic comfort. Some of the projects provided new wings, and "corps de batimens" attached to the Tuileries, next the garden; others on the other side of that palace, next the Carrousel. It had been, ever since 1805, a favourite project to transfer the great national library of the Rue Richelieu to the new constructions; and, throughout, one of the absolute conditions was to maintain the two main thoroughfares for even public vehicles, which have existed ever since the time of Louis XV.

Louis XVIII. continued, in 1820, the wing constructed by Napoleon, for an extent of some 70 or 80 feet. He died in 1823, and the brief reign of Charles X. succeeded, but no further addition was made. Louis Philippe, although promoting architectural works in Paris, thought it wiser to complete

the other public edifices, which he found in progress when he mounted the throne, rather than to begin a new project of such enormous cost. These were numerous and expensive operations, and certainly Paris, at his expulsion, had assumed a more complete aspect than it had ever hitherto done. After the Revolution of February, when the Republic was proclaimed, the project of the junction of the palaces was revived, as a judicious mode of tranquillizing the turbulent disposition of the working classes, apt to create "*emeutes*" when not employed.

In 1835, Mons. Brunet Debaines, now of Havre, and our Honorary and Corresponding Member, prepared a very fine and comprehensive plan for the additional family and household accommodation in connection with the Tuileries, and for the allocation of the National Library, galleries for the exhibition of works of industry, and also for the opera house and chateau d'eau in the Place du Palais Royal. He forms a central square in the Carrousel, 900 ft. wide by 750 ft. long: at each corner of the present Carrousel, next the Tuileries and next the Louvre, he forms masses of buildings with a central court, projecting about 200 ft. into the court from the long sides, north and south, extending 400 ft. from the Tuileries and the Louvre respectively: thus resolving the great court into a species of Greek cross. In each of the masses of buildings next the Tuileries he forms two courts for stables and coach-houses, domestic offices, accommodation for the persons attached to the Court, and family conveniences for the Royal Family, compactly disposed. The courts next the Louvre are respectively appropriated to buildings for the library, and to an extension of the picture galleries.

My friend Mons. Dusillion exhibited a design in 1849, the leading features of which are similar to Mons. Visconti's. He continues the wing begun by Napoleon up to the place opened in front of the Palais Royal; here the line of frontage then breaks back about 25 ft., and its direction is changed so as to be at right angles to the place and to the axis of his new building. By another slight break just beyond the place it forms another recess, and is continued until it comes in a line with the wing of the Louvre built by Percier and Fontaine, where it turns round to meet the Carrousel. At the distance from the Tuileries of about two-thirds the length of the court, Mons. Dusillion throws a building quite across on the line of the axis of the Place du Palais Royal, with two projecting wings producing a noble inner court next the Louvre, 500 ft. wide by 400 ft. deep, called that of the Bibliotheque Nationale, and smaller courts, 100 ft. wide, are enclosed within the "*corps de batimens.*" His conception is simple and dignified. He preserves the axial *allinements*, and still a noble extent for the Carrousel of 1050 ft. × 900 ft. Faithful to one idea, Mons. Dusillion devotes the whole of his new building to the reception of the vast collection of books, medals, and other objects of the great National Library, by a very imposing and convenient distribution of halls, staircases, and galleries; and their junction with the Louvre is direct and easy. Any addition to the domestic accommodation of the palace of the Tuileries forms no part of this design.

The Design of Monsieur Visconti.

To comprehend properly this project, we must understand the programme traced by the hand of his Sovereign, and which it had to satisfy; the idea of transferring the National Library to this site was abandoned. The Emperor Louis Napoleon wished, that accommodation should be provided for the residence and administration of his two Ministers, to whom was confided the execution of all public affairs. His Majesty also desired that provision should be made for the periodical exhibition of the works of modern artists, so as to relieve the pictures of the old masters in the Louvre from being covered up, and those galleries from being appropriated for that purpose, as had hitherto been necessarily the case. There was to be stabling for 140 horses, and coach-houses for 50 carriages for the use of the Emperor and public purposes.

Let us now see how this has been accomplished. Mons. Visconti has continued the line of front next the Rue de Rivoli in one continuous direction, and without any other break than slight projections here and there to relieve the monotony of an uninterrupted façade. On the axis of the Place du Palais Royal he introduces a central entrance to the ministries, and carries out into the Carrousel a block of building 700 ft. long × 290 ft. deep, projecting into the grande place 230 ft., and containing two large courts averaging 200 ft. × 140, and one less court 140 ft. × 80. This block he appropriates to the two Ministries of State and their dependencies. From the long gallery next the Seine he throws out a like block into the Carrousel, 600 ft. long × 230 ft. deep, with two courts larger than those previously described, and a similar smaller court. A very grand staircase will lead to the first floor, which, as well as the entrance floor, is to be appropriated to the annual exhibition of modern works of art; they will also connect with the galleries of the Louvre containing the old masters. In the centre will be a most splendid hall, two stories high, richly decorated, 67 ft. wide, 200 ft. long; this will be used for the meeting of the "Corps d'Etat" when the Emperor wishes to convoke them. There will be a riding-house of like size beneath in one clear span, and in the basement story the stabling for 140 horses, and under the old gallery next the Seine the coach-houses for the 50 carriages.

The central block in the right wing facing the Palais Royal, and on the same axis as it, will form a noble entrance hall, vestibule, and thoroughfare for foot-passengers and private carriages going from the Place du Palais Royal to the Place Louis Napoleon, as the space between the two wings is to be called, the centre being occupied by ornamental gardens, like the square gardens in London, with fountains and statues of Louis XIV. and Napoleon I. In the centre, porticoes will face the Place Louis Napoleon, decorated with marble statues of the great men of France, and the whole architecture will correspond in style with that of the Louvre, with a more discriminate use of decoration and a greater relief by contrast. The present plain front of the Louvre facing the Tuileries will be made to correspond with the new building by a little more ornamentation than it at present possesses, for when originally designed by Pierre Lescot, it only faced inferior streets and dwellings, and was therefore executed with great simplicity and absence of decoration. To those so well competent to judge of the ability and reasonableness of this disposition of plan it is needless for me to offer any comment upon the skill and taste which have conceived it. But I cannot forbear to observe that it harmonizes and blends together the two incongruous and apparently incompatible masses of the old palaces—it reconciles the obliquity of the wings—it preserves the vista from the façade of the Tuileries up to the Louvre—by the judicious contraction of the Place Louis Napoleon it renders appreciable the vastness of the Carrousel,* still of gigantic extent, about 900 ft. square, sufficient to manœuvre squadrons of cavalry, and encamp (in case of need) its thousands of troops. There still, however, remains to be provided domestic, family, and household accommodation for the comfort of the Royal inhabitants, and hereafter will have to be added in contiguity to the Tuileries, and, either in the Carrousel or on the garden side, masses of building, to render this a comfortably habitable, as well as the most vast and sumptuous palatial residence in the world.

These colossal operations of the Louvre are but part of a vast series of improvements now carrying out, as you are aware, in Paris. The present Emperor, with his usual penetration, feels the full importance of giving employment to the industrial classes, of encouraging the fine arts, as among the finest illustrations of his reign, and contributing to the refinement of the people and the improvement of manufacturing productions. He equally appreciates all the influences upon the

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* Size of Lincoln's Inn Square, 845 ft. × 625. Size of Russell Square, 700 ft. square.

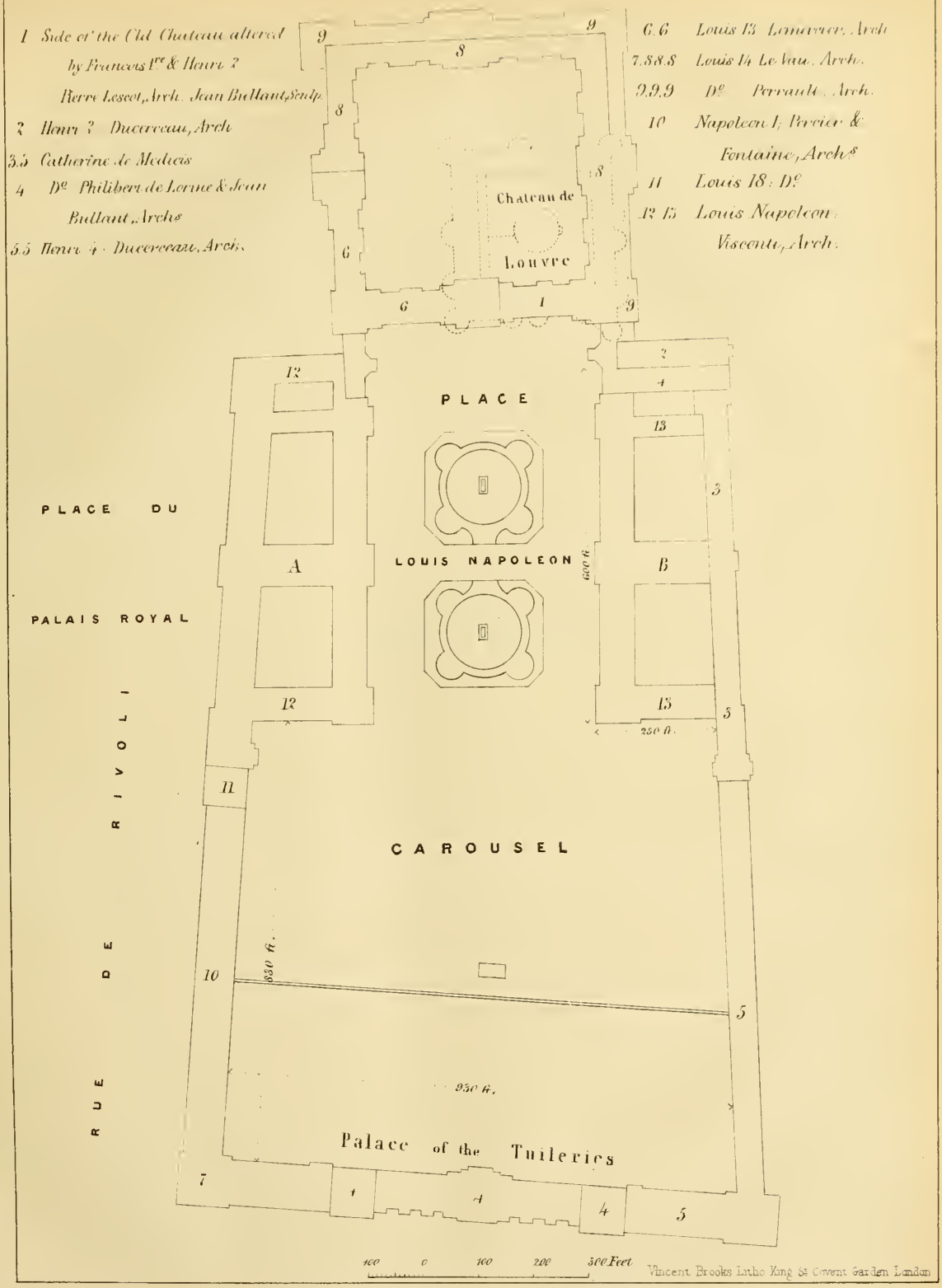
health of the metropolis, and the advantages to commerce derivable from clearing away the old closely confined quarters, and opening up new lines of thoroughfares. The works at the Louvre are a portion of this extensive scale of operations to be promptly and vigorously carried out. The decree for the works necessary for this object was dated the 12th March, 1852, and a sum of one million and twenty-seven thousand pounds to be expended in five years, judged requisite. The first stone was laid on the 25th July following, and at the end of the same year the north wing had been carried up 6½ ft. above the level of the Rue de Rivoli. During the last year the contracts were entered into for the masonry, carpentry, and iron work for nearly all the parts of the new buildings to the extent of £800,000. In March last year 1200 workmen were employed, increasing in numbers until November, when 3000 were on the works, and in December, 2000.

192,000 cube yards of earth have been removed; and there have been worked up—109,000 cubic yards of stone and concrete; 300,000 kilogramme of iron are already used.

In 1852 were expended	£47,800
„ 1853 „	227,040
Making together	274,840
Besides other outlays, amounting to	48,714
Already expended	£323,554

The premature death of our lamented friend Mons. Visconti, the highly gifted architect, in December last was a grievous loss; but so unremitting had been his attention, so ready his conception, that, when I visited Paris in October last, he showed me between 150 and 200 drawings of details, which he had prepared; and in which the particulars were so minutely specified, that the work, if carried out agreeably to them, will have that unity and grandeur of conception and refinement of taste in every part, that will stamp this as one of the greatest works of the age. The architect, with noble disinterestedness casting aside all personal considerations, has conformed to the style of the original type, and will leave it as an inspiration of the 16th century, matured by the experience, refinement, and masculine good sense of the 19th.

Note.—The preceding historical details are founded upon the information contained in the following Works, in addition to the writer's personal knowledge of the buildings in question:—Des plus excellents Bastiments de France; par Jacques Androuet Du Cerceau, 2 vols. folio, Paris, 1576-1607. Mémoires sur la Réunion du Palais Imperial des Tuileries et du Louvre, et Plans de diverses dispositions pour l'achèvement de la Place du Carrousel; par Baltard, Architecte, folio, Paris, 1811. Arc de Triomphe des Tuileries, érigé en 1806, d'après les dessins et sous la direction de MM. C. Percier et P. F. L. Fontaine, oblong folio, Paris, no date: (containing numerous projects by various authors for the union of the Louvre and Tuileries.) Projet de Restauration et de Réunion des Tuileries au Louvre; par L. Fortuné Brunet-Debaines, Architecte, small folio, 1835. Description Historique et Graphique du Louvre et des Tuileries; par M. le Comte De Clarac, Conservateur des Antiques du Louvre, 8vo. Paris, 1853.


1 Side of the Old Chateau altered by Francois 1re & Henri 2 Pierre Lescot, Arch. Jean Bullant, Sculp.
2 Henri 2 Ducerceau, Arch
3.3 Catherine de Medicis
4 De Philibert de Lorme & Jean Bullant, Archs
5.5 Henri 4 Ducerceau, Arch.
6.6 Louis 13 Lemercier, Arch
7.8.8.8 Louis 14 Le Vau, Arch.
9.9.9 De Perrault, Arch.
10 Napoleon 1, Percier & Fontaine, Archs
11 Louis 18 De
12.13 Louis Napoleon Visconti, Arch.
Chateau de Louvre
PLACE
PLACE DU
PALAIS ROYAL
LOUIS NAPOLEON
A
B
600 ft.
250 ft.
RUE DE RIVOLI
CAROUSEL
850 ft.
350 ft.
Palace of the Tuileries
100 0 100 200 300 Feet
Vincent Brooks Lith. to King & Covent Garden London

PLAN OF THE LOUVRE & TUILERIES, PARIS,
with the additions for the Completion & Union of these Palaces.

ON THE DRAINAGE OF BUILDINGS AND STREETS IN THE METROPOLIS.

By W. A. Boulnois, Associate.

Read at the Ordinary General Meeting of the Royal Institute of British Architects, March 20th, 1854.

In venturing to offer a paper on this subject to the Institute I have not been influenced by a desire to communicate any special experience or information of my own, but simply by a wish to induce a discussion upon the controversy which, as we all know, has long existed, upon the methods and schemes of house drainage. The question lately received a great deal of attention at the Institution of Civil Engineers, and complaints have been loudly made by some of the disputants that their opinions did not receive sufficient notice in those digests or summaries of the proceedings in which the Institution is wont to condense the information derived from a debate. Here they will be able to express their opinions without reservation, none of our principal members being, as far as I am aware, pledged, as they contend the principal members of the other house were, to one side of the question; and they will be reported precisely in proportion to the clearness and accuracy of their remarks.

Every member of this Institute is, I am sure, anxious that the subject of drains should be well ventilated, however doubtful he may be as to the manner in which the drains themselves can best be so.

It would really appear strange to any man unacquainted with the deep-rooted prejudices, and the hot-headed partisanship of Englishmen, that a matter involving their most important interest, their health, their money and their pride, should not ere this have been fixed upon such principles, that though there might remain a disappointed opposing few, the vast majority would have been entirely of one mind. When we consider the composition and character of the respective Boards of Metropolitan Commissioners of Sewers, since the public has been roused to the need of efficient servants in that capacity, the talent and ability of almost all their officers, we are fairly surprised that a controversy should be still raging as well on the things to be done as the manner of doing them. It is not too much to say that the ablest men of the kingdom have occupied themselves generally with the sewer question. It has been the disagreement of professional men upon details, which has alone prevented their labour from bearing fruit. And now that we are nearer to a settlement of the question, we find that the finances necessary to carry out the measure, have not been considered or provided for, as it was not worth while to prepare the way for expenditure, whilst the manner in which the money should be spent was undetermined. Surely it should be the earnest wish of all right-minded men, without prejudice against new-fangled notions, as they are termed, on the one hand, or an absurd retention of theories unsupported by practice on the other, to arrive at such a conclusion on this subject as shall obviate the evils complained of. This is not to be done by avoiding controversy within such walls as these or in papers and pamphlets, in which facts and opinions can be stated and refuted, but by abstaining from abuse of all parts of a given system of drainage, because one's own nostrum is not in it; by abstaining from false and overstrained statements of wasteful expenditure as it is termed, because our own nostrum is not experimented upon; and especially from a system of hand grenade penny-a-line warfare, which has been the destruction of all the respect usually felt by the public for bodies of scientific men who are desirous to serve it with honour.

It is a custom with architects now, I think, much more honoured in the observance than in the breach, to begin all descriptions of practice with a reference to the ancient methods. I cannot do the justice to this part of the subject which it deserves, and which many here present could, but in con-

firmation of what was said the other night as to the antiquity of the claims which most modern inventors set up, I may refer to some portions of tubular drains brought from Ephesus and Miletus by my friend Mr. Falkener, which are now on the table. I learn from him that there is ocular demonstration of the use of similar drains at Pompeii; in one case the hollow in which the pan was bedded in the wall clearly indicates its shape; it was on the first floor, and from the curious arrangement of the syphons, which are described as existing in the ornamental arches of the City, we may fairly conclude that the Pompeians had WATER closets. As the drains were laid under the ornamental pavements through the principal portions of the house, and centred in the impluvium passing away in one channel through the prothyrum or passage, we may conclude that probably, from a greater fall, better workmanship, and the constant running of water which took place from the fountain in each house, they did not require to be so frequently laid open as ours do. No excavations have been made which shew the size of the sewers in the streets at Pompeii, and it is greatly to be wished that some one competent would investigate this subject—permission would readily be granted for the purpose by the authorities at Naples to any one so well recommended, as an advocate of the pipe system would now probably be, by the Secretary of State for the Home Department.

At Pompeii there are indications that the same construction of the street water-courses under the pavement or trottoir, which exists now in the Corso, at Rome, was practised.

I have endeavoured to explain this by the drawing on the wall: the water-course is entirely under the pavement, which is of travertine, hollowed to form a series of long arches over it. There are some advantages connected with this method which might warrant its adoption in our streets; a much greater fall could be given to the water-course so as to obviate those elongated puddles, which after heavy rains are not uncommon near the gulley heads in our streets: the kirbs would not be so much worn as they are at present from the custom of using them as trams by weighty carts, and the horses would be relieved from the strains—necessary to remove heavily laden vehicles from them. I have been informed that this is the most fruitful cause of jibbing in horses, and that in some parts of London it is a serious injury to the omnibus proprietors.

The pipe drainage advocates having antiquity on their side as regards house drains, it is satisfactory, on the score of an even debate, to find for the large sewer advocates, the CLOACA MAXIMA at Rome. We are, however, indebted for more than would first appear of our present system to the Romans. Our system of sewers originated in the covering in of open water courses, and at the Fleet-ditch and the Wallbrook sewers, old Roman brickwork is intermingled with modern work, or was until quite recently. The present adaptation of the sewers has been the growth of a long and very costly rule of thumb system. All the men who have since Wren's time been consulted about sewers, and they are not few, were probably unable to apply, even if they were acquainted with, the principles of hydrodynamics. They were employed on piecemeal improvements, and it is fortunate for us that the earliest of them did their work so well as to set tolerable examples before the ignorant parish authorities and inefficient surveyors, who, until comparatively modern times, have managed the drainage of London. It is a subject of great congratulation, as it seems to me, that of the 1,000 miles of sewers constructed under the Commissioners, and the 50 miles of City sewers, there should be such a large proportion which is useful, when we consider its progressive development, the divided interests which have worked it out, and the uncertain and hap-hazard way in which the extensions to this great town have been made. It is quite certain, moreover, that we have derived all our present knowledge of the subject from the imperfections of the previous works, so that we have in that way largely benefited by the mistakes of our forefathers.

The division of the subject of the removal of refuse from the buildings and streets of the metropolis, which is most simple, and admits of the readiest discussion, is into DRAINAGE, SEWERAGE, and OUTFALL. DRAINAGE has to be considered under the head of *subsoil drainage*, *surface drainage*, and *house drainage*. The necessity of subsoil drainage in a locality entirely sublaid by an impermeable stratum, such as the London clay, needs no argument; and though it has been, and is ignored by many Sanitary Reformers, it is in fact almost as important as the house drainage. Damp soils and damp basements to houses are as constant and as deadly destroyers of human life as all the foul emanations of undrained refuse. The economy of effecting this subsoil drainage by the same sewer which is to convey the house drainage admits of no question, as it seems to me; and it is very efficienty provided for by the construction now adopted in the sewers of the Metropolitan Commission, which are built in cement to the height of the internal flow, and in mortar over this, which admits of the percolation of the water in the soil above and around them. The City has long been pre-eminent in respect of its subsoil drainage over almost all towns in the world.

One of the places most insisted upon as an experimental proof of the efficacy of the pipe drainage is Tottenham. Now there is a portion of Tottenham, lately called Marsh Lane, but now Northumberland Park, where the system of the Board of Health has been most efficiently carried out by Mr. Pilbrow; the houses are well drained, but the subsoil drainage not being provided for, the basements after heavy rains stand in water: the year before last the water rose in the basements of some, which I had occasion to visit, 18 inches, and had so saturated the walls as to injure them permanently. Had the drainage been according to the system of the Metropolitan Commissioners of Sewers, this most serious evil would have been avoided, and the house drainage equally good. I am aware that a sufficient fall could only have been obtained at a great distance, and that the present system is the only one the place could yet pay for; but it affords a strong proof of the great gain which, when there is opportunity, arises from the combining the subsoil and house drainage.

The surface drainage, by which is meant the removal of the rain water, is that branch of the subject which opens up the question of small or large sewers. The rain-water which falls on a given area, would seem to be specially intended for the cleansing of the refuse which may be on the surface, and very good reasons should be given why this is objectionable as applied through the sewers before we depart from so natural and obvious a use of them. The chief reason given by those who seek to separate surface and house drainage is an economical one, the cost of the sewers they say may be reduced to such an extent that you can have two systems, one for house and the other for surface drains, at a less expenditure than you can construct your sewer large enough for both. Now granting for the moment that the systems of small sewers will do for *house drainage*, as perhaps it will in some special and favourable cases, it is unquestionable that sewers large enough for the passage of a man to clean them would be required for the rain water or surface drainage in this metropolis, the detritus from Macadamized roads forms a concrete much more difficult to remove than all obstructions in sullage, and no gulleys (of which one of the best forms as found in the experience of the Metropolitan Commissioners is exhibited on the wall,) are able to prevent this deposit from accumulating in our sewers.

We in this Metropolis, with our levels, if we desire to be able to cross our streets without boats, and occupy the basements of our houses for more than two hundred and fifty out of the three hundred and sixty-five days in the year, must have sewers for the rain water, not of the theoretical size requisite to carry off a given rainfall, but of size sufficient to admit of these sewers being approached for cleaning.

The economical reasoning therefore fails.

The theory so carefully elaborated in some of the treatises on drainage, of forming surface drains

literally at the surface, and only covered by the requisite thickness of stone or other material to protect them from the carriage traffic, and admit of their being easily cleansed of the road-dirt, forgets that the front areas and rear portions of London houses, the gardens, and the basement areas are usually 12 or 14 feet below the street level, and totally neglects them.

Having then the necessity for large sewers for the *surface drainage*, and of deep sewers for the *subsoil drainage*, we are next to inquire into their applicability to *house drainage*, or the substitution of other methods. Great improvements have within the last half century taken place in the *house drainage* of the Metropolis, independent of the question of the size of the drains. Cesspools are, I believe, no longer contended for. Water-closets are considered essentials by a class of people, whose fathers would have as soon expected to ride in their own coaches as use them; and that periodical and dreadful infliction upon Mr. Paterfamilias of "something wrong with the drains" is within the houses at any rate, less frequent than formerly. This last effect is doubtless attributable to the general use of the tubular pottery drain, not that all the improvements have been made with it, but because the builders and bricklayers who would not use it, were compelled in support of their prejudice in favour of the old barrel drain, and for the honour of the cause, to build their brick drains somewhat more smoothly than they had been in the habit of doing. The main cause of improvement, however, is the information which was given to practical men by scientific men upon the necessity of an uniform inclination in place of the flat incline and sudden fall near the sewer, which was commonly adopted in house drains, and the knowledge which has reached even housemaids and footmen, that a good scour of water through the drains is better obtained by a plug under the lifted water-closet handle during the coming in of the water supply than by the old and time honoured expedient of pouring pailful by pailful down the grating in the back area.

Greatly indebted we are to the sanitary reformers on this subject, and we may offer ourselves the same congratulations upon their experience as we do on the practices of our fathers; we know now what to avoid. Their two inch pipes from sinks, three inch house drains, and four inch combined drains, are now as much things of the past amongst practical men as a cess-pool under the centre of the front kitchens; four inch pipes from sinks, and six inch from water-closets, are the smallest which practice has warranted us in adopting. Theory proves, and proves satisfactorily that a three inch pipe with the inclination ordinarily obtainable in London, would be enough to carry off the refuse from a first class house, but practice has discovered such frequent stoppages even of four inch pipes, that they are now scarcely ever used.

I could give the history of numerous and various individual failures which have arisen, but others will occur to all the members. We are sometimes told that these are *preventible stoppages*, and that the small drain gives increased cleansing power to the water in the contents, and is so much better as to warrant the adoption of the means to prevent the insertion of improper substances at greater cost than we are now accustomed to do: in other words, that the trap should be improved and altered. How often would even the three inch drain be quite full of water so as to push the substance in suspense before it? This great and inherent evil of *stoppages* is sometimes met by saying that you must teach the people not to put matters down the drain which will cause stoppage, and that a population must be thoroughly imbued with the belief that the omission and commission of sins against the drains will cause a recoil upon themselves in disease and death; but we must change the character of the human mind before this desirable period will arrive; do not men commit sins of omission and commission upon the ducts and sewers in their own bodies, knowing that they will recoil in the shape of disease and death?

The most fruitful causes of the failure of pipes have been the joints; butt joints are specially liable

to this observation: when laid in ground which is not very solid and consistent, the lengths are liable to shift and an irregularity causes a lodgement of a small portion of the matters floating down; once begun, the evil speedily accumulates, the obstruction gathers from each passing substance which is not of sufficient tenacity to resist it, and eventually entirely chokes the pipe.

With reference to whole socket pipes, practical men are divided in their opinion as to whether they are best set in clay or cement; for my own part I think it essential to pipe drainage that no extraneous matter should possibly get into the pipe from the outside, and I think they are best set in cement. All house drains are best waterproof, a stoppage may, if this is not the case, exist for a long time in a drain without detection, as the fluid sewage oozes through the joints and saturates the surrounding ground. In a gravelly or sandy soil this evil may have been proceeding for months without notice. Half socket pipes I think are the best, as they offer the opportunity of removal without breaking them upon the occurrence of stoppages, and it is more easy to determine when they are accurately laid, the upper semicircles of the two pipes abutting against one another affording a good test of this. The thicknesses of the pipes have, with very sound judgment, as it seems to me, been increased by the resolution of the Metropolitan Commissioners of Sewers; they must now be $\frac{1}{2}$ in. for 4 in., $\frac{3}{4}$ for 6 in., 1 in. for 9 in., and $1\frac{1}{4}$ in. for 12 in. beyond this. The Commissioners do not permit pipe drains within their jurisdiction, as they have been found to break and cause great damage and expense.

The glazing of the tubes inside, though very desirable and of indirect utility in causing a better pipe to be burnt than would otherwise be, is not of any material assistance to the flow of the sewage matter through them. There forms in all sewers a sort of slime against the sides and bottom, which is after a very short period as efficacious in giving a smoothness of bore as the most expensive glaze would be. Too much attention cannot be paid to the bedding of the tubes at a true inclination, a very small error in the levels being of much more importance than in a large drain, where there is opportunity for adjustment of an even inclination in the current: it is obvious that 3 inches wrong with a 6 in. tube on a very flat incline, will be equivalent to the stopping up of half the tube.

With reference to the question of using *back combined drainage*, or *a separate drain* from each house to the sewer in the street, there are many considerations which are not usually taken into account by those who advocate the first of these systems. We have seen that street sewers are necessary on account of the necessity for *surface drains*, and that they must be so large for this special purpose as to admit of their being applied also to receive the *house drainage*, (I do not apprehend that the most earnest advocate of back drainage ever proposed that the surface drainage of the street should be at the rear of the houses). We have then to consider whether it is better that the block of houses should be drained at the rear in the back courts or gardens by a combined drain which is turned into this sewer at one point, or that each house in the block should have its separate opening into this sewer. I pass by the considerations of invasion of private property involved in the combined back system, and the more serious danger of intentional stoppage and cutting off the drains, of which perhaps nearly all of us here have seen instances, as they are by no means uncommon. I pass by the necessity which in almost all cases there would be, that the combined drainage of the whole block should flow under the end return house, and the much greater liability there would be that a stoppage should occur in the small drain, say of 12 in. diameter, than in the sewer in the front, and that all the inmates of houses in the block would be the sufferers for the neglect of one. I pass by these considerations, though they are enough to prevent the adoption of back drainage without strong local reasons in its favour, and I come to the main point at issue between the advocates of one system and the other, viz. the economy. Now, first we must have a drain from the front area in all streets, so that we have the length of the drain from the front area to the water-closets, and sink in the basements

and the back area, if there is one, to set against the length of the drain from the water-closet and sink to the back combined drain, and the frontage of this combined drain along the house. Almost invariably with modern houses in blocks, there are rear projections, which are quite as wide as the front area, generally they are wider, we have therefore to set the extra length of the pipe in the house, (on the supposition that the sink and water-closets are at the rear as they usually are) against the frontage, and we have in this to set 12 in. pipe frontage, and one 12 in. T piece, diminishing to 6 in. against a straight 6 in. pipe through the house. It is clear that in nineteen cases out of twenty, back combined drainage would be more expensive than separate front drainage, provided they were both equally well done. It suits well perhaps with the views of speculative builders in outlying parts of the town, where there are no basements to the houses, and surface drainage is not yet provided for; the parishes not having had the roads and pathways handed over to them; to obtain permission to insert all along the rear of their blocks before their garden, or back court fence walls are up, a cheap 15 in. drain instead of an efficient sewer in the street; but it is of immense importance that their views should not be complied with to the prejudice of the health of the inhabitants of their houses, and the property of the persons who purchase their interest in the houses when they have let them.

Were each man who builds in this country his own freeholder, there would be no question as to the combined back drainage, it would not be tolerated; and because we have a vicious system of leaseholds which enables such propositions to be entertained and to be hailed by some of the small builders, are we to be told that the Commissioners of Metropolitan Sewers, who have wisely permitted the system only under such local circumstances as make it obviously desirable, are neglecting the objects of their appointment and stifling the truth.

We now come to the second division of the subject—SEWERAGE, by which is meant the arterial drainage from the house drains to the out-fall.

We have arrived in considering subsoil and surface drainage at the fact, that a sewer larger than the theoretical size is necessary, and after making due allowance on that account, we can with tolerable accuracy determine what should be the sizes of the sewers. As they gradually approach their outfalls they receive increased amounts of drainage from the increased area they traverse; the average of the make of sewage over a given area of inhabited houses in London has been tolerably accurately obtained by experiment.

It is found that in six hours in each day, as much sewage comes down as during the remaining eighteen hours; the rainfall is taken by the engineers to the Metropolitan and City Commissioners at $2\frac{1}{2}$ in. over the entire area, after making proper deductions for the effect of evaporation and absorption in dry ground, and upon the formula of the square root of the hydraulic mean depth, multiplied by twice the fall in feet per mile, minus one-tenth for friction, equalling the velocity in feet per second, the capacity of the sewer can be calculated. It is a fact seldom admitted by pipe sewer advocates, but nevertheless true, that many of the old London sewers are too small, as well as many too large, upon this principle.

It is sometimes forgotten in the controversy on the part of the pipe advocates, that upon true hydraulic principles, the sizes of the sewers as calculated for their drainage capability only, soon reach such dimensions as that pipes are no longer available, even if they answered their ends. Besides, were they laid with reference only to the immediate requirement in places where they would be sufficiently large for it, they do not admit of extension to embrace the drainage of an increased number of houses, a point very necessary to be considered on all grounds.

Pipe sewerage may be said to have been well tried in the Metropolis, and to have failed. On the wall, are instances, by no means the worst of the condition of pipe sewers, as ascertained by Mr.

Bazalgette, the engineer to the Metropolitan Commissioners, by their order. Many of these it appears were habitually flushed, and the investigations were made by the officer to the Commission, solely with a view to ascertain the applicability of pipe sewers in the future operations of the Commission. The present shape adopted by the Commission, answers as far as its bottom goes all the ends of a circular sewer in diminished friction, and as the perimeter widens, it must, (by the well-known principle of hydraulics that the resistance of every particle of the fluid is in direct ratio to the perimeter of the section, and inversely, as the area of its section) give beyond the semicircle a greater velocity in feet per second.

The sewers now built under both Commissions, are constructed upon sound hydraulic principles, and we may hope that there is no waste of public money for want of an ample scientific knowledge, both of the requirements, and the best method of answering them.

There are details connected with the sewerage which it is worth while to allude to, as many differences of opinion exist upon them: the ventilation of the sewers is one of these: it is admitted on all hands, I believe, that till we have a perfect water supply, and our sewers are scoured as those of Paris now are, by strong streams of water, provision must be made for the occasional passage of labourers in them to cleanse them. And even when this much to-be-longed-for time arrives, entrance will be necessary for the repairs, which will be rendered more frequently requisite by the scouring. If the sewers are to have labourers in them they must be ventilated, and it is a question which is the best method of effecting this; many schemes have been proposed.

A direct air shaft leading to the centre of the street is adopted by the Metropolitan and City Commissioners, though, they admit, that it is open to great objection. A plan which has been used with success in many places, is to connect the rain water stack pipes with the sewer. Mr. Varley, the water colour painter, read a paper at this Institute, in 1846, descriptive of this method; his diagram is on the wall. Shafts and furnaces for draft have been proposed, but would entail enormous cost. It has been proposed to compel all persons having steam boilers for manufacturing purposes, as brewers, mechanical engineers, and the like, to admit the foul air from sewers to their chimney shafts, but it is doubtful whether this would answer. The chimney shafts would hardly always be in the highest levels and very long adits would have in most cases to be run to the nearest sewer. Dr. Buckland came down here one day to propose that the gas lamps, in certain requisite numbers, should be connected with the sewers by shafts, and that iron cylinders should convey the foul air outside the stalk of the lamp to the flame which would consume it, or destroy its noxious qualities.

Some have proposed, that every house to be built or re-built, should be compelled to have a flue in the party wall for the use of the Commissioners of Sewers, should they need it, to ventilate the sewer at that part; this does not seem an impracticable plan, and perhaps it will be considered in the New Building Act, which, we have been informed, is now in the hands of the Board of Health. At any rate, ventilation in the sewers must be provided.

Flushing, is a point to be noticed in the consideration of sewers. Great improvement has been made in this method of cleansing the sewers, and with a perfect water supply, there is no reason why it should not be extended to such a degree, as to almost entirely obviate other methods, except in flat situations, where raking will probably always be requisite.

A system of flushing has been proposed by Mr. Jennings, (whose clever contrivances in connection with drainage details, entitle him to the thanks of all architects and sanitary reformers, and some of whose inventions surround us), in which the accumulated refuse of each day is released at a given moment from a receptacle constructed under each house, any number, say 100, such receptacles being opened at once by the aid of wires and cranks, or electricity, it is supposed a rush would take place

down the sewers which would clear everything away with it. Another invention by Mr. Salter, to which my attention has been brought by Mr. Jennings, is the self-acting flushing gate, in which by an outflow pipe from the upper level, communicating with a tilted box on the lower level, or in the side entrance, the sewer itself, when full, forces up a catch lever and releases the gate. It is very ingenious, and is recommended from experience by the authorities at Leeds.

Time will not permit me to treat of the many other matters connected with the sewers, which will, I hope, come out in discussion, but we must pass to the OUTFALL, on which I can say but very little, except that having read digests of all the schemes submitted in competition to the Commissioners of Sewers, I do not believe there is one except that of Mr. McLean, for intercepting the higher levels, and taking the lower under the Thames at Vauxhall, which is practicable, without such an enormous outlay of money as to quite preclude it from consideration. The engineer who devoted so much time to the question, and whose health failed him in the attempt to conduct the multiplicity of detail connected with his office simultaneously with the designing of a great scheme, died before he could mature it, and it remained for Messrs. Bazalgette and Haywood to work out plans for the main drainage of the Metropolis. It may be shortly said of this scheme, that the new sewers proposed intercept the present at various levels, and form of themselves the sewers of the districts through which they pass. The schemes have met the approval of Sir William Cubitt and Mr. Robert Stephenson, both eminently practical men, and it is satisfactory to find that Lord Palmerston does not include them in his condemnation of the Metropolitan Commissioners' plans.

Were Lord Palmerston for one week at the Sewers' Office, or even had he to make application there so frequently as we all have, he would have long considered before he took such a violent course as to declare the whole of the proceedings of the Metropolitan Commissioners, since they had been in office, erroneous. Lord Palmerston would have known, that at any rate they had endeavoured to get at the truth; he would have known, that seeing the rock the two previous Commissions had split upon, viz., chimerical scheming in the one case, and a neglect of detail for a grand measure in the other, the Commissioners were now only anxious to do their work so that it should be lasting and beneficial. He would have known, that their officers were selected with the utmost care, and that no crotchets now took up the time of these officers; no endeavours to make out cases, which, if proved, could not be carried out without an entire remodelling of the whole Metropolis; no rival schemes within the very executive office of the Commission taking up the time which the public was paying for; and before he took a step likely always to deter sound men from engaging in the public service voluntarily, he would have waited till he was better informed than he could be by a letter containing heads of a controversy, most of which are long since settled in practical men's minds, and every one of which, had he asked information of the Commissioners, they could have given him sound opinions upon.

I have been this evening informed, on undoubted authority, that an epidemic caused by malaria or the leakage of the drains, has again broken out at Croydon; these warnings require the earnest attention of us all, and they are additional reasons why, when no such complaints as are made about the Croydon drainage can be made of the present well-tried system of the Metropolitan Commission, such a sanatary *coup d' état*, as it has been described to be, as the abolition of the present Commission, upon a presumption that a new and untried system is the best, is particularly to be reprehended.

The CHAIRMAN (Mr. MOCATTA, V.P.,) congratulated the meeting on the very able manner in which a subject of vital importance to the health of the metropolis had been brought forward, and hoped that its discussion might elicit valuable opinions to assist in the adoption of a perfect system of

drainage throughout the country. Considering that this great question had been much discussed, and that more experiments had been made in this than in any other country, it was most extraordinary that they had not hitherto been able to arrive at any correct conclusion on the subject.

Mr. Garling (Fellow) said, that he was much gratified to learn that Mr. Boulnois had a decided objection to the use of pipes for sewers, and also to small sewers generally. Indeed, he considered pipe *sewers* to be both defective and unscientific for the metropolis or for any large town, as the sewers for such places ought to be large enough to enable workmen to enter, and examine and cleanse them. A 12-in. pipe sewer had been lately made in Hatton Garden about 1000 ft. long, intended for the drainage of the houses, as well as for the surface. This size he considered vastly too small, even to carry off the water from the area it was constructed to drain. For in a thunder storm, such as sometimes occurred, and which, therefore, ought to be provided for, sufficient water might fall in one hour to fill such an aperture completely full for a length upwards of three miles long, or about some sixteen times its extent, so that in the event of a stoppage, or the water not running off with sufficient velocity, the consequences might be most serious; and, indeed, there were now repeated complaints of its being the cause of stoppages and overflows in the street in heavy rains, though with very little more than the surface water from the street at present running into it. With reference to this pipe sewer Mr. Garling afterwards observed, that in order to aid its current, it was laid with a fall of $1\frac{1}{4}$ in. in 10 ft., or equal to 55 ft. in a mile, a fall so utterly impracticable on a large scale, that supposing a sewer with such a current to be laid down in Oxford Street (which was about $1\frac{1}{3}$ mile long) and with a water bed 12 ft. deep below the surface of the street at one end, it would be 60 ft. above that surface, or as high as the roofs of the highest houses at the other end. The liability to fracture of pipes used as *sewers* was another objection to the system for the drainage of any large city, from the difficulty of ascertaining the exact place of the defect. The drainage of houses by pipes, assuming a separate drain to each, was less objectionable; but even in house drains a pipe, 6 in. bore, was not ordinarily large enough. He thought there could be no doubt that small drains became stopped up much more frequently than large ones; and he believed that the water ordinary flowing in from closets and sinks was not sufficient to cleanse the small drains commonly used. He knew an instance of a small drain, only 10 ft. long, which was connected with a $4\frac{1}{2}$ in. soldered soil and rain water pipe, being choked up for some months, nothwithstanding there was a head of water standing 45 ft. high in the pipe, and when the drain was opened, the water flowed from the opening like a fountain, spouting up seven or eight feet, and yet it had not been able to force its passage through this short length of small drain. Again, there was an absolute necessity for the admission of air into drains or the water would not flow; this may be by an air vent having communication with the external air as high up as possible to avoid smell, or else with the sewer, which latter some might think strange. A very frequent cause of drains being stopped was their being "air-bound," as it was termed; and another evil resulting from this was, that if the air was not allowed to flow into, and escape from the drains by some other way, the water would be drawn out, or forced out of the air traps, as the case might be, and a stench would arise in consequence. If a drain was not as hermetically sealed as it could be by art, except the necessary vents just named, it would always smell; and a frequent defect causing this was the imperfect connection of the soil and rain water pipes with the drain. These pipes should always have proper flanges at the junction bedded in brickwork in cement. One objection to pipe drains was, that in case of a defect it was difficult to discover its exact position without breaking up, perhaps, the entire drain, or great part of it; and therefore a cemented brick drain, or a drain covered with slate or stone, was preferable in that respect; and this remark of course applied equally to pipe *sewers*. With regard to back drainage

he quite agreed with the arguments urged by Mr. Boulnois; and a further objection was to be found in the fact that what was an area or a back garden at present might hereafter, and perhaps very soon, be built upon, and converted into a house or warehouse; and, therefore, a drain properly placed there as an external drain at one time, would afterwards become an internal one. Experience had amply shewn the force of this remark, not only in the city, and in places like Oxford Street and Piccadilly, where scarcely a back yard was left, but in the suburbs. Moreover, in back drainage, which was not separate drainage of each house, there would also be a difficulty arising from the opposing interest of the different occupiers, who would constantly object to having the drains in their premises opened to discover defects, from which perhaps their neighbours, and not themselves, might be sufferers. The drainage of every house should be distinct from that of the neighbouring houses—there should be no drain running from one house under the others—in which case the basement at the lowest level might suffer from the defect in the drain of the higher one. A case came to his knowledge in Spencer Street, where a house became almost uninhabitable from the stoppage of the drain in other property which it ran through at the back, and the occupant had made repeated efforts to get it opened, but without success. His appeal to the ground landlord's agent was in vain; neither the parish authorities, nor the Commissioners of Sewers, he was told, could give him any relief; and he at last found that his only resource would be to apply to the Court of Chancery. Cases of this kind would constantly occur under the back drainage system, and an immense amount of litigation and inconvenience would ensue. Nearly thirty years ago he had himself advocated in a public Journal many parts of the system recently proposed. He had then declared that no sewerage whatever ought to go into the Thames at any place above Grays; that on the North side of the river there should be a main sewer—say from Chelsea to Grays Reach; that at or about Chelsea there should be large tidal reservoirs to be filled at high water, and at about two-thirds ebb this water should be used occasionally for the purpose of flushing the sewers; and that two large reservoirs should be formed at Grays apart from all dwelling-houses, where the sewerage should be alternately first in one and then in the other, decomposed by chemical means, and removed in barges. Mr. Garling concluded by repeating his objection to pipe sewers and small drains of all sorts. As a general rule he scarcely knew a small drain that did not choke up, nor a large one that did.

Mr. Haywood, C.E., with reference first to the question of main sewers stated, that he was not a thoroughgoing advocate for brick sewers alone, having himself used and intending still to use pipes; but he did so only to the extent, to which, in his opinion, pipes might properly be applied, and not to the extent of the telescopic system as it might be termed. And in this he differed with many advocates of the tubular system. He considered that every town should be judged of by its own conditions, and that the main streets of all towns of ordinary size should have sewers large enough for men to enter, the minor streets being left to the judgment of the engineer. It was necessary that sewers, or ducts of some kind, should be provided for carrying off rain water or storm water, house drainage and subsoil drainage: the latter was a most important point, because a dry basement was a most invaluable advantage; and it was almost as important that a house should be dry, as that it should be free from smells. The question of the best mode of accomplishing all the desired objects was in reality how this could be most ecomonically performed, for it might be done in two or three ways. Some persons advocated three sets of sewers for this purpose. He thought, however, that as a new theory could not be tested for many years, until it was so, a brick sewer, large enough for men to enter, which had been found to answer all the purposes, as being the most simple, was the best. He was convinced that a brick sewer would be found to answer every purpose that could be effected by two or three sets of pipes. Sewers ought to be monumental in their character, and if constructed

in our day, none of us ought to expect to see them replaced by new ones. They ought, indeed, at least, to last for a century, and the sewer in the main street of a town ought never to be broken up till it was worn out. A sewer, whether of brick or pipe, so small that a man could not enter it, should never be employed in such a street. That brick sewers would drain the subsoil effectually might be illustrated by the fact that throughout the city generally they had been able to lower the surface of the water in the gravel as much as six or eight feet; and the basements of many houses, which twenty-five years ago had been almost useless, were now available for the stowage of the most costly materials, such as silks and other goods, and numerous other purposes. He believed the rateable value of the property thus gained was not less than from £20,000. to £30,000. a year. He had now a great number of sewers which had not been opened for years, and which, he believed, never would need to be opened again. With regard to stoppages in pipe sewers, it was stated by their advocates, that it was very easy to obviate them, as they were always found to be preventible stoppages, but where stoppages occurred repeatedly from similar causes they could not be called preventible, but rather constant and unpreventible stoppages, and to that every sewer was subject. Within the last few days one of his pipes had been stopped from end to end. He had built about 120 or 130 pipe sewers, and having used extreme care in their construction he had only had one breakage. With regard to the breakage of pipes, of course that could be obviated, as it would be very easy to make pipes strong enough for all purposes, and the breakage of pipes could not be well alleged as a reason for not using them. He had had two or three trifling stoppages in his pipe sewers, and recently there had been one of a serious nature in Leadenhall Market, a place, the surface of which, of course, could not be broken up with impunity, or without causing great inconvenience. The houses draining into that pipe sewer were occupied by respectable tradesmen, to whom money was not an object, and every appliance had been used in the houses to make both drains and sewer self-acting. The pipe, however, was stopped from end to end, and he could not tell the cause of it, nor whether that cause was preventible or not. He had opened the sewer in three places in a length of 135 ft., but had not broken the pipes. It was doubtful whether that sewer could ever be restored to its integrity again. Referring to one of Mr. Boulnois' diagrams he stated, that when a soft bed of deposited matter once accumulated in a sewer, it became a nucleus which impeded everything passing through it. If he might be permitted to allude to published books, he would refer to a blue book which contained a diagram of the sewer in Holborn, which was within his jurisdiction. In the first place the sewer in this diagram was placed upside down; and further it appeared that a diagram similar to Mr. Boulnois' was shewn to a witness, who was asked two or three extraordinary leading questions, with a view to shew that the brick sewer in Holborn was five or six times the necessary size; because a pipe of the size shewn would carry off all the water of Holborn; but the party had forgotten, or probably did not know, that it was intended to carry off, not only the Holborn water and foul matter, but that of a large area adjacent. There was a curious general advocacy of the tubular system int his blue book, with a vast amount of theorizing on this subject, which, if it proved anything, would prove that a two-in. pipe was large enough for any house of a moderate size. The size, however, of a drain, must be determined by practice, and when the advocates of the very minute system of drains objected that drains, as generally constructed, were double or treble the necessary area required, he, Mr. Haywood, would only reply that, even in determining the sizes of their own drains, they had exceeded the size which their theory pretended to shew was sufficient, and they did so because they said that practically it was necessary to have larger than that given by theory, which Mr. Haywood quite agreed with, and would state, that according to his *practice* a 3 in. drain was not large enough for a house. Ventilation of sewers was absolutely necessary, otherwise they would ventilate themselves

into the houses. The plan of ventilating into the centre of the street, although a bad one was, perhaps, the best that could be adopted at present, as it brought the stream of foul air where it could be the easiest diluted and carried off. With regard to ventilating by the rain water pipes he had found it to answer, although many complaints were made of smell being perceptible in the houses through such mode of ventilation; where the foul air had been conveyed above the chimney-stacks, it appeared in certain conditions of the atmosphere that the effluvium descended again. This was rather a medical question whether it would be better to ventilate in the centre of the street or by the peoples' dwellings, and for himself he was in favour of employing flues; and, he thought that a compulsory measure (such as appeared to be getting fashionable) to make manufacturers allow the use of their flues and tall chimneys for the purpose of ventilating the sewers, might be introduced with advantage, but, he said nothing as to the justice of such a measure. With regard to the drain pipes of Rome and Pompeii he imagined that the Romans collected and applied their fæcal matter to agricultural purposes, as was now done on the continent generally, and that the pipes, of which a specimen was on the table, only carried off the superfluous water of the house. At present one of the great difficulties in Paris was the increasing habit of using water-closets, which had greatly diminished the value of manure, which had brought them hitherto a rental of about £30,000. a year; and, although they abused the Londoners for polluting their river, one of the engineers of Paris had told him, Mr. Haywood, that he was much afraid they would be compelled to do the same, unless the usage of water was restricted. Whatever sized pipes the Romans used to carry off water, it was certain that they used large and flat-bottomed sewers, and the charge of those sewers was deemed a highly important office, as he hoped it would become in this country. Back drainage in this metropolis, he considered, would be fraught with the greatest inconvenience. Where two, three, or four water-closets were close together, one drain might be employed, but to carry the drain through the property of many different occupiers would be a most serious disadvantage. Without interdicting this system in all cases he thought it wrong to lay it down as a general principle, and he quite concurred in the opinions stated by Mr. Garling on this point. The public not seeing the objections to this plan might be carried away by its first cheapness, but the ultimate inconvenience of it would be very great.

Mr. Fowler (Fellow) proposed an adjournment of the discussion, which was unanimously agreed to.

A vote of thanks to Mr. Boulnois was also carried unanimously.

ON THE DRAINAGE OF BUILDINGS AND STREETS IN THE METROPOLIS.

By W. A. Boulnois, Associate.

Being a Discussion, (in continuation of that which took place at the previous Meeting) held at the Ordinary General Meeting of the Royal Institute of British Architects, April 3d, 1854.

The Chairman, Mr. W. S. Inman, V. P. having impressed on the meeting the value of giving an uninterrupted and impartial hearing to the gentlemen who might address them, Mr. J. J. Scoles, Hon. Secretary read a communication from Mr. Thomas Morris, architect, to the following effect:—

There is one point in relation to the subject of Metropolitan drainage now brought under the notice of the Institute, to which I would beg your attention.

It is the presumed applicability of syphon sewers to at least the surface drainage, so as to enable the rainwater flowing from high situations to be passed through depressed localities, and finally discharged at the level of some given channel. Thus if the rain falling in the higher environs of London, such as Camden Town, St. John's Wood, and the districts to the north had to be brought into the Thames at Westminster, it would traverse a locality actually lower than the upper or high water surface of the river Thames, and the flooding of such a locality would be the inevitable result with sewers of the ordinary kind whenever the quantity of rain exceeded the capacity of the sewers, which are to be regarded as reservoirs while the floodgates are shut by the action of the tide. To obviate such an inconvenience I suggested some years ago to the Commissioners of Sewers, that after the water had been allowed to find its way down to a suitable level by the simple law of gravitation, means for its further progress should be provided by pipes, similar to those of the water companies, which within limits of height, well known to every architect, would allow of such undulations as the intervening surface might require. Thus a reservoir at the level of Piccadilly might have its eduction pipe carried below the level of St. James' Park and the lowest parts of Westminster, and raised up over the embankment of the river, so as to pour a continuous current into the Thames, at all states of the tide. Intercepting sewers of very considerable length would by this means be wholly obviated, and the enormous expense of their construction avoided. The pipes, it may be mentioned, would not exhaust themselves, but act on the principle of intermitting syphons.

Mr. Bazalgette, C. E. observed that whilst the professions of Engineering and Architecture were united in many branches, this was especially the case with regard to drainage. The main drainage of a town was the business of the hydraulic engineer, but all the details of house drainage were within the province of the architect, who was necessarily called in when any defect occurred, and expected to provide a remedy. Architects therefore were the best judges as to what systems of house drainage acted well or ill, and the opinions which would be expressed in this discussion would be of great value from their practical nature and the experience of which they were the result. In one remark made by Mr. Boulnois, he could not concur. That gentleman had stated, that "the disagreement of professional men upon the details" of the subject had led to the evils which had occurred. He (Mr. Bazalgette) had carefully studied the question, and was of opinion that practical and professional men were not at variance upon it, but that the controversy was between them upon the one hand, and *non-professional* and *non-practical* men upon the other. This was his opinion, though it certainly had for a time been shaken by some of the views which had been put forth in the "Builder," a paper with which he knew some professional men of high repute were connected, and which he regarded as expressing the opinions of architects in general. In the last number of the "Builder," a very fair account of Mr. Boulnois' paper had appeared; it was followed by a statement, headed "Progress of the manufacture of Tubular Drain Pipes," which shewed the great increase in the quantity of drain pipes

annually manufactured since the year 1848, and which was easily explained by the increased attention that had been given to sanitary measures since that period. The article referred to proceeded to state, "it is estimated that in the metropolis about 15,000 houses have been drained with 4 in. tubular drains, and about half as many with 6 in. drains, while upwards of 250 miles of pipe sewers have been laid down in streets." This statement was very incorrect, and he was at a loss to imagine the source from which it had been derived. The facts were that the whole number of houses drained within the last four years amounted to 26,978, of which

4,926	were	drained	in 1850
8,581	„	„	1851
6,271	„	„	1852
7,200	„	„	1853
Total 26,978			

Of this number 20,000 (instead of 7500, as stated in the Builder) were drained with 6 in. pipes. Now although the numbers had been erroneously stated, it was true that 4 in. pipes had been largely used, but it was equally true that they *had failed* to a great extent, and caused a considerable amount of inconvenience. The present Commissioners of Sewers were often called upon to take up 4 in. and lay down 6 in. pipes, and although they did not feel justified in spending the public money in that way, it was being done to a great extent by private individuals. In the same manner the quantity of pipe sewers ("upwards of 250 miles") had been greatly over stated in the article referred to. They had however been extensively employed, and, as the diagrams of Mr. Boulnois proved, they had been often incautiously applied. Without entering upon a crusade against pipe sewers, he would state what the Commissioners of sewers, with his entire concurrence and recommendation, were now doing. During the last year they executed about 22 miles of public brick sewers and 6 miles of pipe sewers, whilst private individuals had executed about 12 miles of brick sewers, and about 85 miles of pipe sewers and drains; making a total of nearly 35 miles of brick sewers, and nearly 92 miles of pipe sewers and drains. This statement would shew that the Commissioners did not advocate any exclusive system, but that under certain circumstances and for minor branch sewers they considered pipe sewers advantageous. The old practice of brick sewers led to a large expenditure, but did not end in failures, nor produce disease, whereas if the use of the modern pipe was carried beyond its proper limits, failures and obstructions occurred, together with an amount of injury to the public health which could not be estimated by pounds, shillings and pence. Some of the new theorists on drainage announced their systems as the most "economical and efficient," but "the cheapest and best house in London" was generally neither the cheapest nor the best, and a system of drainage which might be most expensive in the first instance might be the cheapest in the end. It had been strongly asserted that pipes, or small sewers, were self-cleansing, whereas large or brick sewers had a sluggish flow and became in fact merely elongated cesspools. He could state most positively from experience that this was not the case. It was true that some of the large sewers in London were not self-cleansing, but this was because they were situated in low and flat districts, with their outlets pent up for eight hours at a time by the tide; but from their size they were easily entered and cleansed by workmen, and certainly pipe sewers in the same situations would allow deposit to be made in the same ratio. In fact, taking the best and most modern forms of brick and pipe sewers of the last ten years, and laying them side by side with a tolerable fall under exactly the same circumstances, he could assert that the self-cleansing powers of both would be equal. The representations in Blue Books of brick sewers half filled with deposit were drawn from old sewers without sufficient water flowing through them, many of them now abandoned, and were not fair representations of the existing state of the London sewers.

Mr. Bazalgette proceeded to show by reference to the diagrams that the proportion of the sectional area of the sewage water to the frictional surface of the sewer or drain over which it flowed, in conjunction with the fall, governed the self-cleansing power, and that egg shaped brick sewers of proper dimensions had the advantage over small pipe sewers in this respect, especially in the event of overcharge from storm waters, while they also enabled men to remove the heavy road drift which was so likely to produce stoppages in the latter. All sewers became in time covered internally with a slimy surface, which produced an equality of smoothness between bricks and pipes, and in execution the bottom of a brick sewer could be made more uniformly smooth, and consequently less likely to create an obstruction than a pipe with numerous joints. Comparing 4 in. with 6 in. pipes, Mr. Bazalgette applied the theory of the proportion of area to frictional surface, and contended that the scouring power in the former when three parts full would be practically the same as in the latter when half full, and that the 6 in. pipe had an advantage in allowing small substances to pass, which in the smaller pipes would remain and become the nucleus of an obstruction. It had been said that many towns were successfully drained by small pipe sewers. Now he had been directed to visit some of these places, namely, Barnard Castle, Tottenham, Rugby, St. Thomas's Exeter, and Sandgate; and he found that the pipes had been laid down only two or three years and in no case had the drainage been completed, whereas it was obviously necessary to have the experience of a system for at least five to six years before it could be called successful. Again, in those towns which were represented as entirely drained by pipe sewers, he found there was the former system still in use for surface and subsoil drainage, the modern one, of pipes, draining the houses only. At Sandgate two-thirds of the main lines had required to be taken up in consequence of stoppages. When he was there pipes were opened for this reason, and when water from the main was turned on it would not flow through the pipe, and he was surprised to find that the drainage had in fact forced its way through the joints, and had been oozing through the gravelly soil for some time; this was a most serious objection to the use of pipe sewers, as embracing all the evils of the cesspool system. In some of these places they had openings by which the pipes might be inspected, but if the joints were defective, this mode of inspecting, at certain points only, would be useless, and much mischief might be done before the stoppage was discovered. With reference again to the use of small pipes, it was obvious that a larger pipe would allow for a greater amount of sinking in the ground on which it was laid than a smaller pipe. Pipe sewers should therefore be laid larger than the *theoretic* size, to allow for casualties and defects. On the subject of combined back drainage, Mr. Bazalgette admitted that there were circumstances in which it might be economical and advantageous, but as a general rule applied to London it would be neither the cheapest nor the best system. The experiments and formulæ of the great philosophers who had studied this subject could not be disregarded, and it was evident from these that a torrent of rain or storm water could not pass through a 6, 9, or 12 inch pipe from a large area. One of the diagrams before the meeting represented the Fleet Sewer, with a sketch of a Locomotive Engine within it as a scale to shew its immense size, but he (Mr. Bazalgette) knew that on one occasion a few years ago even that sewer was not large enough to carry off the flood water from Hampstead, &c. Whether separate or combined house drainage were adopted, a sewer in the middle of the street for the surface drainage was essential in all large towns, whatever might suffice from mere country roads, and this point, though it materially affected the question of economy, had been overlooked by the advocates of back drainage. Mr. Bazalgette produced a drawing in illustration of the comparison between separate and combined house drainage, and contended that both for economy and efficiency the former system was the better one. In the separate drainage system, each house drain could be probed from the common sewer, without interfering with the adjoining houses in any respect. He further adverted to the difficulty arising from the conflicting interests of different owners, which would prevent the removal of obstructions without the exercise of the legal powers vested in the Commissioners, and likewise referred to the frequent erection of workshops or warehouses in the rear of

houses, which would render back drainage further objectionable. Upon the whole, except in poor outlying districts, where as a matter of economy, or to get rid of the greater nuisance of a cesspool, combined drainage might be introduced, the separate system was the best. He considered that in the case of valuable property, where stoppages in the streets and injury to trade was of the most serious consequence, it was essential to adopt large sewers and the separate system, as that which would interfere the least with the trade and traffic. Mr. Boulnois had dwelt upon the breaking of pipe sewers, but he (Mr. Bazalgette) was of opinion that the manufacture of pipes had been greatly improved, and that they might be made strong enough to bear any amount of pressure; although, of course, the cost was increased by the additional thickness. He considered the half socket as the best kind of joint. As to the ventilation of sewers, he found that pipes from them carried above the roofs of houses were liable to the escape of effluvium by leakage, or that the smell was brought down to the windows by eddy currents in certain states of the atmosphere. He believed that a system of ventilation by furnaces, as adopted in mines, would be the best plan; but that in the meantime the present system of ventilation, through gratings into the middle of the street, was the best plan that had been practised. He could not approve of Mr. Boulnois' suggestion of a channel for the surface water beneath the foot-pavement, used in the Corso at Rome, inasmuch as straw and dirt would be washed into it, producing floodings, and causing much trouble and inconvenience.

Mr. Burnell, C.E., referred to the plan called "en encorbellement," formerly adopted in Paris, of using a small channel worked in the granite curb and under the pavement to carry off the surface water. It had been there found, however, that horses were very liable to slip and break their legs in consequence of these gutters, and the use of them was, therefore, generally discontinued. The Romans confined their proceedings to land drainage and surface water—a description of which was to be found in Columella's, Cato the Elder's, and in Varro's Works "de re rusticâ"—any system like the modern sewerage did not exist either at Pompeii, or in any other Roman town. Mr. Boulnois had adverted to the system of sewerage adopted in Paris, and he was sorry to observe that Lord Shaftesbury had praised that system in the House of Lords. The fact however was, that there was no sewerage, in one sense of the word, in that city, and although a few houses and hospitals were said to have their sewage conveyed into the main drains, this practice rendered private parties liable to a heavy penalty, which the Municipality rigidly enforced. The whole extent of the main drains executed in Paris up to the year 1852 was about 90 miles, whereas the Commissioners of Sewers in our own metropolis had executed 35 miles in one year. All the sewers of Paris were large enough to allow a man to enter, the bottoms were segmental, and the minimum fall was about 2 in 1,000. But in Paris there were cesspools beneath *every house*, and although great care and superintendance was exercised in their construction, and excellent materials were used *(meulière and hydraulic lime)*, the filtration from the cesspools was so considerable that the well waters had been pronounced by chemists to be unfit for the ordinary purposes of life. Any person who had walked the streets of Paris at night could not have failed to discover that all these cesspools were necessarily opened occasionally. Mr. Burnell added, that it was too much the practice in Blue Books and with Boards of Health to assume when any convenient phrase or formula had been hit upon that it expressed a fact. Thus the terms "self-cleansing sewers" and "sewers of deposit" had been much used; but a sewer was a passive object, and consequently these expressions were as erroneous in grammar as they were repugnant to common sense. The expressions hill-top and valley water were exposed to the same comment. The Board of Health had laid it down as one of these "formulæ" that 80 gallons of water per diem should be allowed as a proper supply to each house, but at Croydon 200 to 500 gallons had been given to each house to carry out the cleansing of these, so called, self-cleansing small tubular drains. Amongst the objections to back drainage one had been overlooked, namely—that the land upon which it was effected became public property, and therefore the introduction of the system would occasion an interference with private rights, to which the people of

England were unaccustomed. Still cases might arise in which from peculiar circumstances back drainage might be desirable; and in the course of his own experience he had been asked by the Commissioners of Sewers to allow another property to be drained through that for which he was concerned; but on another occasion when he proposed back drainage for two houses, and offered to give up their yards to the public, the Commissioners of Sewers refused to allow it.

Mr. T. H. Wyatt, V.P., thought the Institute much indebted to Mr. Boulnois for bringing before them with much clearness and ability a subject of so important and practical a nature. Whilst agreeing with almost all his views on this point he (Mr. Wyatt) regretted that Mr. Boulnois had thought it necessary to give, as an additional reason for introducing this subject, alleged discontent on the part of some members of the Institution of Civil Engineers, as to the manner in which the summaries of discussions at that society were prepared, and at a want of impartiality on the part of its leading members. Having the honour to be a Member of the Institution of Civil Engineers he (Mr. Wyatt) could not allow such an imputation to pass uncontradicted. The subject had been most fully discussed there; and he ventured to assert, that any member who had the courage to express his opinions at those discussions, would have been heard with the most perfect fairness. He believed that the summaries of the proceedings in that society represented faithfully the general views of the different speakers, and it was absurd to suppose that the leading men of that Institution were one atom more "pledged" or prejudiced on a great public question than any member of this Institute. One thing, however, was certain, that the Institute of British Architects was not the place for members of the Engineers' Institution to seek redress for supposed wrongs. The Council of their own body was the only proper channel of appeal. In confirmation of the evils of small pipe drainage Mr. Wyatt produced a portion of deposit of *fat* fully 1½ in. thick, which had attached itself to the inner circumference of a 6 in. glazed earthenware pipe, laid about two years ago at St. Luke's Hospital, and completely stopped the free passage of the water and flooded the front area. This deposit was found at a distance of more than 200 ft. from the scullery, where gratings and a trap had been introduced to catch any extraneous matter; with the exception of the sinks and boilers in the scullery nothing drained into these pipes but rain water and the overflow from a large tank at the commencement of the drain. These 6 in. pipes had been taken up and larger ones laid down. Mr. Wyatt quite agreed with Mr. Burnell that in matters like that under discussion, it was a frequent error to take stereotyped "dicta" for ascertained facts; and it was a dangerous fashion to circulate cut and dried plans for Drainage, Schools, Churches, and Parsonages, as applicable for *general use*, instead of dealing with *each individual* case as its own circumstances and peculiarities demanded.

Mr. Boulnois, Associate, said that his observation at the last meeting was that complaints had been loudly made of the want of proper digests of the opinions expressed at the Institution of Civil Engineers. In making that observation he had merely reiterated what was said week after week in the "Builder."

Mr. Wyatt did not assert that Mr. Boulnois had given the opinion as his own, but he had, as it were, taken it for granted, and at any rate had implied that there must be ground for such a charge, otherwise he would not have dwelt on the fact that *here* "they would be able to express their opinion without reservation, and would be reported precisely in proportion to the clearness and accuracy of their remarks." Mr. Wyatt held that the Institute of British Architects should not be made a refuge for the destitute, or the disaffected of other societies.

Mr. Papworth, Fellow, inquired what Mr. Bazalgette considered to be the greatest amount of internal pressure to which a 6 in. pipe would be subjected.

Mr. Bazalgette did not assume any pressure till a stoppage took place, and then it would depend upon the head of water.

Mr. Papworth then inquired what head of water could be stopped up in a 6 in. pipe?

Mr. Bazalgette said that he was not prepared to answer that question from any practical experience.

The Chairman suggested that the answer would be given by Mr. Bazalgette's stating the hydraulic proof which he usually put upon drain pipes.

Mr. Bazalgette said that hydraulic proof was not applied to the pipes—the actual test to which they were subjected was the external pressure which would crush them. The 6 in. pipes bore the test, but the 15 and 18 in. pipes were so frequently crushed, that until the manufacture was improved the Commissioners would not use any larger than 12 in. diameter. In practice it was found that the 6 in. pipes did not burst, but became stopped up. The external pressure would vary with the depth at which the pipes were laid, and the nature of the soil. He was not aware that pipes were proved by internal pressure, but he knew that when they were first introduced the Board of Health endeavoured to employ them as water mains, and in those cases they burst, and iron pipes were substituted.

In answer to a question from Mr. Papworth, Mr. Haywood, C.E. said, that the gullies in Paris were not trapped, and that a vast quantity of fæcal matter passed into the sewers, notwithstanding the Municipal prohibition.

Mr. Burnell stated that according to the experiments of M. Boussingault there was at least ten times as much ammonia in the atmosphere of Paris as there was in the open country.

Mr. Haywood, gave the particulars of the pipe sewer in Leadenhall Market, which had become stopped up as stated by him at the last meeting. It was 135 feet long and 12 inches in diameter, with a fall of 1 in 120; eight houses drained into it, and these were all fitted with water closets and syphon pans. It was stopped up from end to end, and he was unable to state the cause, and whether it arose from preventible causes or not. No doubt pipes could be made strong enough to bear 200 feet head of water, but the difficulty was to join them securely: and this was the cause of the failure when the Board of Health attempted to employ 2 feet pipes for water mains.

Mr. Doulton, Visitor, expressed his regret that views of the most opposite nature and carried to the greatest extent in each direction had been expressed by the advocates of the different systems of drainage. Thus they had at one time been told that there was no necessity for brick sewers at all, and at another that it was extremely improper to lay a 12 in. pipe under a carriage way. Again a 4 in. pipe was said to be sufficient for any house drainage, and soon afterwards it was acknowledged that though a 9 in. pipe might be sufficient, a 12 in. pipe would be better. At first, pipes were made exceedingly and injudiciously thin, but now it was contended that a 12 in. pipe should be 1½ in. thick. It appeared to him that the truth lay midway between these extremes. The same remark applied to the diagrams of the drains and sewers. In the Blue Books there were illustrations of brick sewers which would almost prevent any person building a brick sewer again, whilst some of Mr. Boulnois' drawings shewed such representation of defects and stoppages in pipes as would deter any one from laying down a pipe again; indeed he believed these drawings would have produced a very erroneous impression if the apparent facts had not been modified by the remarks of Mr. Haywood and Mr. Bazalgette. The former gentleman had distinctly stated that the use of pipes was a great and most important improvement in drainage operations. The pipe system like all other novelties had energetic supporters, whose enthusiasm might be pardonable; and although pipes had been injudiciously applied, it would be most unscientific to conclude that it was not desirable to use them as sewers. Mr. Boulnois had stated that pipe sewers in the Metropolis had failed, but the remarks he made appeared to be rather in contradiction to the deductions he drew from them. He admitted that pipes had been laid with efficiency, but all that he had said seemed to bear against the introduction of pipes at all (No, No,), at all events, except under special circumstances. Considering that the pipe sewers had been so recently introduced, that they were laid under very disadvantageous circumstances by persons unacquainted with the proper mode,

and that many persons were prejudiced against them as a novelty, he thought it wonderful that there had not been more stoppages than had actually occurred. He attributed those stoppages to the defective way in which the pipes had been laid. Why a concrete foundation should be applied to brick and not to pipe sewers he could not imagine, and if concrete had always been applied to the latter, as it was now, he believed the occasional sinking would have been prevented. Mr. Haywood had very properly stated that pipes could be made of any required strength, and engineers and architects were to blame if they did not stipulate for a proper amount of strength. As soon as the rage for cheapness which existed a year and a half ago had subsided, the pipes were made thicker, but of course the cost was increased in proportion, and it should be borne in mind that excellence in the manufacture was more essential than mere thickness, the thickest pipe not being always the strongest. A 12 in. pipe, 1 in. thick, if well vitrified, would be stronger and better than if its thickness were increased to $1\frac{1}{4}$ in. or $1\frac{1}{2}$ in. as the manufacture and burning would be better with the inch thickness. Experience had suggested many improvements in laying the pipes, and the failures bore but a small proportion to the amount of pipes laid. Pipes were now being laid with great prudence and judgment in such a way that they might easily be approached from side entrances and examined, and they were laid in straight lengths and not upon the intricate system adopted two years ago. He did not consider the porous nature of brick to be favourable for the formation of the slimy coating to which some value had been attributed: the vitrified internal surface of the tube would be more certain in its effects. In conclusion, he had observed that however various the theories expressed by different persons, their practice was very similar, inasmuch as those who most strongly advocated the pipe system occasionally used brick sewers, whilst those who advocated brick sewers frequently laid down pipes. This at all events was the result of his own experience and observation.

Mr. Fowler. Fellow, observed, that Mr. Boulnois had divided the subject into three branches, and that of these the first two had to his mind been satisfactorily disposed of. The third branch of the subject, that of *outfall*, or ultimate disposal of the sewage matter remained for discussion, if the meeting thought it desirable; and he therefore proposed that its consideration should be adjourned till another evening.

Mr. C. H. Smith, Visitor, said that the remarks which had been made respecting pipes assumed that they were perfect when laid down, whereas he had seen many which had been broken or cracked in transit; and unless actually broken to pieces they were laid down, and, as might have been expected, they had failed, in some cases even before the building was completed. When laid, it would often happen that by imperfect filling in the pressure upon the pipes would not be uniform; but if it were uniform a very thin pipe would bear an enormous pressure. This might be illustrated by the pressure which would be resisted by the small bottles used for pneumatic experiments, and even by a common hen's egg. Pipe drains might fail from the causes he had mentioned, but a brick drain once properly constructed would always remain sound.

Mr. Christopher, Fellow, differed with Mr. Bazalgette, as to the greatest amount of deposit being found in old and abandoned sewers. In his own district (Hammersmith) there were two main sewers. One of these which had only been constructed ten years was frequently liable to most serious deposit, and had now been for three months in course of emptying by hand labour, being filled up to two-thirds of its capacity by solid deposit. The other was an older sewer (3 ft. 6 in.) and although there was a large flow of water down it occasionally, it also was being emptied. Mr. Bazalgette's theory as to the scouring power would not apply when a deposit had been formed; and the cleansing he had referred to absorbed the whole local sewer rate of 6d. in the pound, with the exception of a small margin for staff, &c., leaving nothing whatever towards constructing new sewers.

Mr. Bazalgette stated that he had intended his remarks to be of general application. The sewers of London for the most part were clean where they had a tolerably good fall, and a moderate quantity

of water passing through them, and if the road drift could not be carried away, they might be kept clear by raking. It was plain that the sewers mentioned by Mr. Christopher, had not sufficient fall in proportion to the quantity of water passing through them to make them self-cleansing, and pipe sewers in the same circumstances would be constantly stopped up. In these instances, the deposit could be removed without disturbing the sewers or breaking up the streets, which would not be the case with pipes.

Mr. Pocock, Fellow, said that in the question of sewers, as in other affairs, only practical men knew how and when to modify the theory, as modified it must be occasionally. The frequent changes and interruptions which had occurred in the proceedings of the bodies having the management of the sewers, even when they were going on satisfactorily, had tended to impede rather than to promote improvements. He proceeded to narrate a case in which he was concerned where he had erected at different periods two sides of a square. In the first instance he applied to the Westminster Commissioners for permission to put in a 3 feet. 6 in. sewer, which he thought large enough to drain thirty-six houses, and seeing no prospect for years of getting any outlet to the South, he proposed to connect this sewer with another to the Northwards; and although certainly this was not the most direct way to the Thames, the Commissioners would not have objected to draining a level surface as he proposed, if it had not been for the opposition of an energetic theorist in the Board who would not listen to the proposition, simply because the new sewer was to the North of the Thames, and therefore as he contended, *must* drain directly towards it. The consequence was that the Board after several years delay spent a considerable sum to lower a 2 ft. 6 in. sewer into which he had to drain his 4 ft. 6 in. sewer (the size insisted on) through an intermediate 1 ft. 6 in. barrel drain. When the reign of this body had come to an end, he erected sixteen houses on the other side of the square, and again proposed a 3 ft. 6 in. sewer, but now nothing would do but a 9 inch pipe! This however he resisted, and was fortified by one of the contractors, who said he would advise him to have cesspools rather than a pipe sewer, and that he would build him a 3 ft. 6 in. sewer for the same cost as the 9 in. and 12 in. pipe sewer to which the Board, were at length willing to accede. He (Mr. Pocock) resisted the board until his tenants complained, when he urged them to complain of him to the Commissioners, and the result was, that they gave way, and he put in the the 3 ft. 6 in. brick sewer. Generally, although a 6 in. pipe would make a very good house drain, it was impossible to use a pipe for a sewer in a public road, with either economy or efficiency. The chief advautage of a pipe was its economy, and this advantage ceased if the pipe was more than 9 inches in diameter, for an 18 inch brick barrel drain was not more expensive than a 12 inch pipe. The frequent complaints against the opening of the public roads for the repairs of sewers, gas, and water pipes sufficiently shewed the tendency of the public mind, and should be a warning to advocates of pipe drainage.

The Chairman proposed the thanks of the meeting to Mr. Bazalgette, and the other gentlemen who had given them the benefit of their experience, and moved the further adjournment of the discussion. He stated that the use of drain tiles, and the system of flushing sewers were not modern inventions, that the latter had been found in the ruins of Fountains Abbey, and he described the ingenious system by which, in the time of Cardinal Wolsey, the water of the moat, which surrounded Hampton Court Palace, had been made to flush and carry off the sewerage of the Palace. The original supply of water from Coombe was conducted under the river Thames by an aqueduct, known as the Longford River, and these services were maintained to the present time in perfect operation.

Correction in the Paper read March 20th.

Page 91, line 14, and following lines, should read thus—The thickness of pipes must now be $\frac{1}{2}$ in. for 4 in., $\frac{3}{4}$ in. for 6 in. 1 in. for 9 in., and $1\frac{1}{4}$ in. for 12 in. Beyond this the Commissioners do not permit pipe drains within their jurisdiction, as they have been found to break and cause great damage and expense.

ON THE OPEN SPACES OF OUR METROPOLIS.

By S. Angell, Fellow.

Read at an intermediate Ordinary General Meeting of the Royal Institute of British Architects, May 8th, 1854.

The somewhat exclusive title of my paper induces a very natural wish on the part of its author, that on examination there may be found in it "more than meets the eye" in the words themselves, though I fear I must not allow myself to indulge in such a consolatory aspiration; for on glancing over our great Metropolitan Chart, I observe but comparatively few important sites left unencumbered by ever expanding bricks and mortar, with the bright exception of "London's silent highway," the majestic Thames!

The immediate purport of this paper is to secure (as far as may be practicable) from future encroachments such open spaces as are now left to us; an attempt which I am the more induced to make by the now daily increasing desire in corporate and parochial bodies to adorn and improve our cities and towns. With this view it has occurred to me that some memoranda culled from the "wise saws" of our old Chronicles, and from the "modern instances" of our living authors, might afford useful information for our guidance; these, with my humble services as your Cicerone, I now offer during half-an-hour's imaginary ramble through the "open spaces of our Metropolis."

Proposing at the outset to take "high ground," I can only regret that I have not a "Mons Capitolinus" for my summit level; in the absence of so crowning an eminence, I thought I could establish a Mons Palatinus on Tower Hill as my starting point, for Fitzstephen says, "on the east of London stands the Palatine Tower," but having consulted Dugdale and Wren, I believe the Palatine Tower referred to must have been at Castle Baynard; we must therefore, I consider, be content with Tower Hill without such lofty pretensions.

The historical associations connected with this spot are of intense interest, but on this occasion I feel that I must confine my remarks to the topographical part of my subject.

Stow describes the site thus, "Tower Hill, sometime a large plot of ground, now greatly straitened by encroachments (unlawfully made and suffered) for gardens and houses." I am inclined to think, however, that these encroachments have since been removed to make way for two of the most successful buildings of the present century, the Trinity House and the Mint, which stand on a very airy and refreshing open breathing spot, which I have always found more free from fog and smoke than any other in the Metropolis. I must not venture into the precincts of the Tower itself; the military engineers having taken possession of the architect's department, any remarks on my part might, perhaps, not be considered coming within the civil bounds of professional etiquette.

Descending from my *pseudo* Palatine, I approach the less aspiring "Fish Street Hill," which is, however, not without its glories, for upon it "was one great house which pertained for some time to Edward the Black Prince;" it formed also the main approach to old London bridge, and it still possesses two of Wren's choicest works, the Monument, and the Church of St. Magnus.

Travelling onward, I will not detain you at St. Mary-at-Hill, St. Dunstan's, Dowgate, or St. Bennet's Hills, nor need I stop on the declivity to the Fleet river (now arched over) by Ludgate on the south line of main thoroughfare, nor on that of the north by Newgate,

"Where from Snow Hill, black steepy torrents run;"

a Charybdis more dreaded by civic navigators than the Scylla-like obstructions of Middle Row; but

even this omnibus engulphing vortex may, I hope, before long be raised to its proper level: we surely need not despair when we see the energetic doings of the London corporation in the immediate vicinity, and know that one of its most influential officers, in his grand and comprehensive plan for a "central city terminus," made one "fell swoop" of this abominable blockade of progress and free communication.

Although I have for many years been acquainted with Saffron Hill, I have not found it to be a *district* possessing many attractions, I will therefore proceed with you to the more verdant and salubrious height of Primrose Hill, (London's "Aventine mount," if you please), once the favorite resort of Londoners. It forms part of a large estate belonging to Eton College, and although its immediate site is, I trust, for ever secured to the public, its once picturesque ascent and its tree crowned summit are now sadly shorn of their former beauties; bricks and mortar have displaced its verdure, and I fear the most indefatigable botanist would now find great difficulty in discovering a solitary specimen of the flower from which the hill derives its name.

I possess a small view of Primrose Hill taken in its flourishing days by that truly English artist, Thomas Girtin, the fellow student of Turner, and one of the first to lead the way to that perfection to which the art of painting in water colours attained, before the modern style of "relievo" in body colour was introduced.

Our Parks come next in the order of my series. St. James' Park was first formed by Henry VIII, but it appears to have reached its zenith in the reign of Charles II, who is said to have employed a Dr. Morrison upon its embellishment; others claim for Le Notre the merit of laying out the grounds, which contain about 87 acres. Rosamond's pond, the Canal, and the Decoy, have all now disappeared, and though the antiquary may lament their loss, the lovers of the picturesque are perhaps of opinion, that the present appearance of the park is fully as agreeable as it could have been in the days of the "Merrie Monarch," Nell Gwynn, Killigrew, and His Grace of Buckingham.

The adjacent Green Park was originally called Upper St. James' Park; it contains about 56 acres but was formerly larger, a portion having been taken off in the reign of George III, to enlarge the gardens of Buckingham House. On the east side there are some noble mansions. Spencer house (the work of Vardy), one of our palatial gems; Stafford House, and Bridgewater House. I regret I cannot extend my admiration to the Royal buildings on the opposite boundary of this park.

Hyde Park is stated to have been enclosed with brick walls in the time of Charles II. It was formerly a deer park, in which the French ambassador hunted with Edward VI. in 1550. It has always been celebrated for its drives and promenades. Pepys relates, that he used to ride there in his coach, and that on one occasion he met the Duke of York, "who did eye my wife mightily." If the gossiping Secretary could see Hyde Park at the present day, I wonder what his exclamations would be upon the Colossus from the Monte Cavallo! and on the Cavallo perched upon the Arco Colosso!

George IV, when Regent, gave us an additional Metropolitan lung in the park named after his title, and we are indebted to the skill of the late Mr. Nash for its general arrangement and plan; it contains with its surrounding terraces, altogether about 450 acres.

At the eastern extremity of London we have Victoria Park, (another modern creation), and on my list I next find Whetstone Park; but as I am not acquainted with any beauties in it to describe, nor the number of acres to enumerate, I will pass on to Battersea Park, which can scarcely yet be considered *in esse;* while Highbury Park, which I fear is still *in nubibus*, I have not ventured to include in my catalogue.

Our public Gardens may not inappropriately follow our Parks. Kensington Gardens are "par

excellenee" *the Gardens* of the Metropolis; they originally eontained only 26 aeres, to whieh Queen Anne added 30, and George the Second's Queen 300, making altogether 356 acres, where—

"The dames of Britain oft in crowds repair
To gravel walks and unpolluted air,
Here while the town in damps and darkness lies,
They breathe in sunshine, and see azure skies."

Spring Gardens, which in the time of Charles I and II, had a bathing pond, pheasant yard, and bowling green, in the reign of Victoria, present no other rural feature than the name.

Privy Gardens have in like manner undergone a change, and bricks and mortar have now invaded the fair "three and a quarter acres," which Pepys describes as having been laid out in his time in sixteen compartments, having a standing statue in the centre of each.

The Temple Gardens are fortunately still preserved to us in nearly all their integrity represented in Canaletto's views; long, long, may they continue with their green plots, and flowers, and fountains "sparkling in the sun," and in the sweet words of Elia, "So may the fresh coloured and cleanly nursery maid, who, by leave, airs her playful charge in your stately gardens, drop her prettiest blushing curtsy as ye pass, reductive of juvenescent emotion."

Gray's Inn Gardens are also well preserved, and I expect are not very far different from what they were in the days of the Spectator and the Tatler, saving the encroachments of Verulam and Raymond's Buildings. Lord Bacon is said to have planted some of the trees, and Howell, writing from Venice in 1621, to Mr. Richard Altham, in Gray's Inn, says, "I would I had you here (in Venice), with a wish, and you would not desire in haste to be at Gray's Inn, though I hold your walks to be the pleasantest place about London, and that you have there the choicest society." Mr. Cunningham, in his instructive "Hand-book of London" observes, that the Gardens in Charles the Second's time possessed an uninterrupted view towards Highgate and Hampstead—"We are stepping westward," says Mr. Cunningham—"Moorfields gave way to Gray's Inn, Gray's Inn to the Mall in St. James' Park; the Mall to the Ring, and the Ring to the Long Walk in Kensington Gardens."

Hatton Garden's flourishing days seem to have departed in Evelyn's time; for the good knight describes the foundations being laid out "for a longe streete and buildings designed for a little towne, lately an ample garden."

Many of the City Companies' Halls have gardens attached to them, the principal of which are those belonging to Drapers' Hall, in Throgmorton Street, which contain nearly two acres. These gardens are interesting to the London antiquary from the circumstances so minutely related by Stow, of the arbitrary proceedings in 1541, of Thomas Cromwell, Earl of Essex. Stow's father had a garden there, of half of which the Earl deprived him; he tells us, "no warning was given him, or other answer, when he spake to the surveyors of that work, but that their master, Sir Thomas, commanded them so to do; no man durst go to argue the matter, but each man lost his land, and my father paid his whole rent, which was 6s. 6d. the year, for that half which was left." Old Stow adds, "Thus much of my own knowledge have I thought good to note, that the sudden rising of some men causeth them to forget themselves." Ward, in his "London Spy," commends these gardens as a fashionable promenade "an hour before dinner time." In 1552, we find the following regulations for these gardens—"The Gardyner to suffer no strangers to bowle, in case there be any of the Company disposed to bowle in the place; neither to take erbys or fruite."

In our own days, we have our Zoological and Botanical Gardens, richly compensating us for the loss of the Bear Garden in Bankside, the Dog and Duck in St. George's Fields, and the Cock Pit at Whitehall.

The Fields of London as well as our Gardens require some notice, and although it is complained that we have now "no more fields," we have still the open spaces, if not "the daisy'd banks embroidered o'er." Of these, for extent, Lincoln's Inn Fields claim the first notice. The earliest accounts describe them as the resort of bad characters, and as being used for breaking in horses.

In the Daily Journal 9th July, 1735, we find that "the plan for beautifying Lincoln's Inn Fields is now before His Grace the Duke of Newcastle; there are to be four iron gates, one at each corner, and dwarf walls with iron palisades, this plan has been agreed to by the inhabitants."

In the reign of Charles II, Thomas Sadler, a notorious thief, who had the supreme daring to steal the mace and purse of Lord Chancellor Finch, made a mock procession with his booty at night through Lincoln's Inn Fields; and in our own days mobs have assembled there to agitate questions of supposed political grievances.

On the south side of the Square is the College of Surgeons, originally the work of Dance, but since altered and enlarged by Sir Charles Barry. On the west, stand Newcastle House, Powis House, and Lindsey House, the works of Inigo Jones; on the north side, is the Museum (formerly the residence) of Sir John Soane, a real lover and munificent patron of art, whose liberal feelings towards this Institute must always be gratefully remembered.

The east side of Lincoln's Inn Fields, which was formerly separated from the adjoining gardens by a low wall, now presents a successful group of buildings in the mediæval style, the first important work of a young friend of mine, who appears determined that the name of Hardwick shall continue to be associated with success in art, and worthy of the recent honour so deservedly bestowed by this Institute on his esteemed father. We have all heard that the area of Lincoln's Inn Fields is equal to the base of the great Pyramid. I must honestly confess myself no advocate for covering this most noble "of our open spaces" with buildings, however useful or ornamental they may be; though we appear by no means anxious to avail ourselves of this our largest "open space," by providing good access to it.

Moorfields, within my own recollection, were bounded on the south side by a long gloomy foreign looking building with pavillions at the ends enclosed by a high brick wall, with entrance piers surmounted by those master pieces of Cibber, so characteristic of the abode of which they appeared to form a part. We must all rejoice that this Hospital has been removed to a more open and spacious situation in St. George's Fields, where, thanks to the philanthropy and common sense of the age, the lunatic is now treated with skill and kindness, and that immediately opposite to the site of the former repulsive fabric, there now stands a building devoted to the purposes of literature and science.

Casting a glance only at Goodman's Fields, Spital Fields, Tothill Fields, Spa Fields, and passing through Bartholomew Close, we enter that celebrated field, where, in days of yore, a Lord Mayor of London won his spurs, and William Walworth's unerring dagger became the heraldic emblem of London's chivalry.

The site of Smithfield is as full of historical interest as Tower Hill itself, and its reminiscences are about as painful; whatever may be its future destination, I feel confident that those who have the control will devote it to the purposes best suited to the requirements of the age, with a due regard to the interests of the adjoining Royal Hospital of St. Bartholomew.

The Squares of London are well deserving a few words of notice; they form one of the most agreeable features of our Metropolis, and I am not acquainted with any Continental City in which they are equalled in point of number or in general arrangement.

St. James' Square, formed in 1676, has always been inhabited by the gentry and nobility. There are some noble mansions in it—the residence of our noble President, Norfolk House by

Brettingham, Lichfield House by Athenian Stuart, and London House by the present accomplished Professor of Architecture at the Royal Academy.

Grosvenor Square, so called after Sir Richard Grosvenor who died in 1732, also possesses many noble mansions, and has more of an aristocratic air than any other of our London Squares. An equestrian statue of George III., formerly in the centre, has disappeared. Portman Square, commenced in 1764, was not completed till twenty years afterwards. Manchester Square was formed in 1776. Cavendish Square was laid out in 1718; the North side, which was reserved for the residence of the Duke of Chandos, has been since built over, the two centre houses being, I believe, from the designs of Sir William Chambers. On the west side stands Harcourt house, inhabited by the Duke of Portland, which presents with its high court walls and "porte-cochère," more of the appearance of a Parisian mansion than any other house in London. The equestrian statue in the centre is that of the Duke of Cumberland, and on the South side there has lately been placed a statue of the lamented Lord George Bentinck.

Hanover Square, named in honour of George I. was formed about 1718. This Square in connection with George Street has always struck me as one of the most scenic architectural displays that London presents; the street expanding towards the square, the unique and elegant style of the surrounding mansions, the judicious mixture of red brick and stone, Chantrey's statue and the successful ecclesiastical work of James altogether produce the most agreeable effect.

Leicester Square was built about 1635. On the North side was formerly the residence of the Prince of Wales, father of George III. Hogarth, Sir Joshua Reynolds, and the celebrated John Hunter, the surgeon, dwelt here; and in St. Martin's Street adjoining, the immortal Newton lived!

I do not know whether we may consider this Square as one of the lungs of St. Martin's parish, if it is, I fear its respiratory action must be somewhat impeded by the large obstruction now formed in its centre.

I cannot take leave of this Square without a passing word of praise on the clever and original design of the Panopticon, the successful work of a talented young member of this Institute.

Trafalgar Square claims a front rank in our list of "open spaces," more particularly when putting forth its claim, as "the finest site in Europe." When the decorative accompaniments to Nelson's column are completed, and George IV. is allowed to have an equestrian companion on the now vacant pedestal, we may perhaps be better enabled to decide upon the merits of Trafalgar Square.

Of the Piazza proper of Covent Garden, I may remark that it was designed by Inigo Jones in 1631, with the Arcade as at present on the North and East sides, the Church on the West, and the wall of Bedford house on the South—the mansion was taken down in 1704; next this wall was a grove of trees where the market used to be held. In the centre of the Square was placed a column with a dial.

Gay has well described the Church and the Square in these expressive lines:—

> "Where Covent Garden's famous Temple stands,
> That boasts the work of Jones' immortal hands,
> Columns with plain magnificence appear,
> And graceful porches lead along the Square."

The present market was built in 1830, our brother member, Mr. Fowler, being the architect.

I must not weary you by a tour through the other squares of the Metropolis, in Belgravia, Tyburnia, and Westminster. Bloomsbury, which the Grand Duke Cosmo was taken to see as one of the wonders of England, Finsbury and the Minories, all put in a claim for their "open quadrangular

spaces," and in that gigantic effort of Post Office literature, the Directory, I am told that more than 100 will be found enumerated. I am sure, therefore, I shall stand excused for having presented a selection only.

Of the Greens in London, Clerkenwell and Bethnal are the only ones that now occur to me. Strype tells us that a mansion was built on the latter in 1570, by John Thorpe, the architect of Holland House.

Of Yards we possess several, but I will only name the two Palace yards, Scotland yard, and Whitehall yard.

The Tenter Ground and the Artillery Ground are both good sized "open spaces;" I believe the latter to be the only one where the military ardour of the citizens has a field for active exercise.

The Markets of London, I fear, will not strictly come under the title of my paper as "open spaces," but I cannot altogether pass them over; however disposed I might feel to place them in the condemned schedule, the great improvements which are now making by the Corporation of London, under the excellent judgment of their architect, in the fields of Copenhagen and on the shores of Billingsgate induce me to look forward to an early period, when the shambles of Newgate Street shall give place to an extension of the paths of literature of Paternoster, and the hides and the beeves, and the fish, the flesh and the fowl of Leadenhall shall find a more suitable abode, and resign their present site to the enlargement of thoroughfares, and the increase of that important branch of industry and commerce, our Colonial market!

There is one attractive feature in most Continental cities, which unfortunately is entirely wanting in London. I allude to planted avenues of approach, or surrounding Boulevards. What can be more agreeable and refreshing when escaping from the town's noisy streets than the shady repose of a leafy avenue? the effect both on entering and on departing is materially affected by the character of the thoroughfare, I trust therefore the day is not far distant, when in direct contrast to our New Road and City Road, Curtain Road and New Cut, we may have a spacious open Via Reggia from the Regent's Park to princely Hampstead, in accordance with the noble design of the accomplished Professor of Architecture of the Royal Academy.

My brother architects will readily recal to their minds those lines of Spratt's, introduced in the Parentalia:—

> "Fountains and trees our wearied pride do please,
> Even in the midst of gilded palaces!
> And in our towns that prospect gives delight
> Which opens round the country to our sight."

I fear by this time your Cicerone—like many others of his class—must have nearly exhausted your patience. May I ask you kindly to extend it to me for a very short period, while I detain you with the most important part of my subject, "St. Paul's Church Yard."

Our indefatigable antiquaries have put in a claim for a temple to Diana on this spot, but Wren, who had a good opportunity of forming a judgment when preparing his foundations, discovered no corroborative proof in support of Apollo or Diana; Sir Christopher's own words are—"I must assert, that having changed all the foundations of St. Paul's, and upon that occasion rummaged all the ground thereabouts, and being very desirous to find some footstep of such a temple, I could not discover any; and therefore can give no more credit to Diana than to Apollo." And in the excavations for Messrs. Cooks' warehouse, no fragments of great antiquity were found, excepting the Runic stone, a cast of which our brother member, Mr. Knowles, has kindly presented to the Institute, and several short pieces of deer's horns—A Stukeley would immediately connect these with a fane to the Goddess,

and rear his temple with the same facility as a Paleologist constructs his gigantic monsters from a dental fragment, or a solitary vertebra. I should much prefer some columnar shafts, and Ionic volutes to these pieces of deer's horns, which I think may possibly have been intended to form rosaries for paternosters. A statue however of a Roman soldier of the 2nd legion was found near the neighbouring Ludgate, and as the topographical inscription under the sculptured boy in the adjoining Pannier Alley informs us,

"That if you search all London round,
Still this you'll find the highest ground."

—it may be reasonably inferred that the site of St. Paul's Church Yard formed an important part of Roman London.

I may here perhaps be allowed to remark, that I doubt whether we have ever justly appreciated the importance and size of the Metropolis in its Roman days; the numerous fragments of mosaic pavement that have been found, the Hypocaust at the Coal Exchange in Lower Thames Street, the numerous specimens of pottery and coins, and the great accumulation of debris, all tend to shew that very considerable buildings must at that period have occupied sites now covered by far less substantial erections.

Stow speaks of a patent of Henry I., granting to the Bishop so much of the Castle Wall, (Castle Baynard of the present day) as should be needful to make the wall of the church, (St. Paul's) and so much as should suffice to make a wall without the way on the north side; and in the time of Edward I., there appears to have been a presentment in the matter of the grant, when it was contended that the whole "soil between the gate called St. Augustin's Gate near the said church and the gate on the West part of the said church towards Ludgate, is High Street, and the King's highway, whereof a great part by the raising of the wall at the East, and the building of houses is now enclosed, and the King's High Street much streightened to the great damage of the whole city." Our ancestors therefore appear to have been fully alive to the importance of "open spaces," and I only regret they were not more successful in resisting those very encroachments which are now only in part cleared away, and to which I shall presently more particularly allude.

My acquaintance with "black letter" literature is too limited to enable me to give you any further account of St. Paul's Churchyard previous to the time of Henry III., in whose reign we learn from Stow, that leave was granted by letters patent to the Bishop, to enclose the churchyard of the said cathedral church and the precinct with a stone wall round about. On the North side of the church was originally a great cloister environing a plot of ground, "of old time called Pardon Churchyard," about which was a richly painted "Dance of Death;" and "over the East side of the cloister was a fair library, and in the midst of the churchyard was also a fair chapel, founded by Gilbert Becket, port-grave and principal magistrate of this city in the reign of King Stephen."

"In the year 1549 the said chapel by commandment of the Duke of Somerset was begun to be pulled down, with the whole cloister, the Dance of Death, the tombs and monuments, so that nothing thereof was left but the bare plot of ground, which is since converted into a garden for the petty canons."

Of Paul's Cross, one of the most interesting objects in London history, Stow tells us, that it was "about the midst" of the churchyard, (it is shown in old engravings at the North East corner); he describes it "as a pulpit cross of timber, mounted upon steps of stone, and covered with lead, in which are sermons preached by learned divines every Sunday in the forenoon; the very antiquity of which cross is to me unknown."

In this part also (the North East angle) was the Campanile, Clochier, or Bell House; Stow describes it as "four square, built of stone, and in the same a most strong frame of timber with four bells, the greatest I have heard—these were called Jesus' bells, and belonged to Jesus Chapel—the same had a great spire of timber covered with lead, with the image of St. Paul on the top, but was pulled down by Sir Miles Partridge in the reign of Henry VIII. The common speech then was, that he did set a hundred pounds upon a cast at dice against it, and so won the said Clochiard and bells of the King."

Our chronicler continues—"then was there on the North side of this churchyard a large charnel house for the bones of the dead, and over it a chapel of an old foundation;" these bones, amounting to more than 1000 cart loads, were removed to "Finsbery field"—(extra-mural interment therefore was considered necessary in those days) and there laid on a moorish ground, which in a short time being raised by the soilage of the city upon them, was able to bear three windmills, (Windmill Street, Moorfields, is no doubt formed upon the spot). The chapel and charnel were converted into dwelling houses, warehouses, and sheds before them, for stationers, in place of the tombs."

I am inclined to think the removal from the charnel house above referred to could not have taken place till after 1552, for we find the pious Latimer, on the 3rd Sunday in Advent in that year, complaining in his sermon—"I do much marvel that London being so rich a city hath not a burial place without, for no doubt it is an unwholesome thing to bury within the city, specially at such a time when there is great sickness, so that many die together. I think verily that many a man taketh his death in Paul's Churchyard, and this I speak of experience, for I myself when I have been there in some mornings to hear the sermons, have felt such an ill-favoured unwholesome savour, that I was the worse for it a great while after, and I think no less but it be the occasion of much sickness and diseases." That Wren also strongly recommended extra-mural interments, appears from his letter to his brother commissioner for building fifty additional churches in London.

Latimer is said to have preached his sermon of the Plough in "the Shrouds" which appears to have been a sort of covered gallery attached to the walls of the cathedral, in which probably the more distinguished portion of the congregation used commonly to be seated, and where the preacher also sometimes took his station when the weather was coarse.

On the North West side of the churchyard, Stow describes the Bishop's Palace wherein "divers Kings have been lodged, and great household hath been kept," and on the South side was the Chapter House, a beautiful piece of work, (shown in Hollar's View) built about the reign of Edward III., but in Stow's time defaced by means of licences granted first to build "low sheds" and then, "high houses."

In Pepys' time, St. Paul's Churchyard appears to have been as much famed for booksellers' shops as Paternoster Row is at the present time, and at the great fire the losses were considerable, "£ 150,000 worth, and all the great booksellers almost undone." Vast stores of books were consumed in the vaults of St. Faith, where according to Evelyn they continued to burn for a week. This is the subterranean church, to which in our early days we attach a mysterious and fabulous history, and to which the lines apply,

"This church needs no repair at all,
For Faith's defended by St. Paul."

From the survey taken by order of the corporation soon after the great fire, for the use of the commissioners of the streets, lanes, &c., (published by Vertue in 1723), we can form a very fair idea of the general state of St. Paul's Churchyard at that period.

St. Paul's school is shown on the plan with an altered "give and take" line of frontage, extending to the North East angle, where according to Treswell's plan, (made as early as 1585) formerly stood St. Paul's gate, leading to Chepe, close to which was the church of St. Michael le Quern, with the "little conduit" at the East end of it, and to the North, Blow Bladder Street, conducting to Newgate market. The houses fronting East to Cheapside, were called Jackanapes Row. The North and South boundaries of the churchyard, which have been described as "the string and the bow," appear with trifling alterations to have been nearly similar to the boundaries as they existed previous to the late improvements connected with Cannon Street, the line extending in a curve from Paul's Chain up to the West end of Watling Street, where formerly was situate "St. Austin's Gate."

The plan of old St. Pauls is very clearly laid down in the city plan with the church of St. Gregory and the Convocation house on the South side. I must not however encroach further upon your time with any account of the old or of the present St. Paul's; those buildings would of themselves afford abundant interesting matter for a separate paper, and I therefore commend them with every confidence for that purpose to the able and learned pen of the present estimable architect Custode.

I must detain you for a few moments at Sir Christopher Wren's drawing office, and at a building which certainly cannot be well overlooked, the Colossal warehouse, lately erected by our brother member, Mr. Knowles, for Messrs. Cook.

The great architect's drawing office was on the South side; it now forms part of St. Paul's Coffee house; there is no mistaking it—from the balcony in front there is a most superb view of the West front, of which I was delighted to see a most successful representation at the Exhibition of the Royal Academy, the performance of a rising young architect, whose distinguished father has shown his profound veneration for Wren in the most elegant testimonial ever produced by kindred genius!

The Colossal warehouse, I think you will agree with me, is fully entitled to that appellation, when I state that its length is 171 feet, average depth 74 feet, height 90 feet, and the cubical contents one million one hundred thousand and fifty feet! I was extremely glad to have the aid of steam power in lifting me to its summit, and the assistance of a guide to point out its extent; but I know not whether my astonishment at its size was not surpassed, when the architect informed me of the rapidity with which the work had been executed, *ninety days only* having elapsed from the time that the first brick was laid, to the period that Messrs. Cook were enabled to resume their business.

To refer again for a moment to "days of old," I will adopt Mr. Knowles' own account of the Runic monument discovered in the excavations for this building.

Mr. Knowles says:—"During the progress of the excavation, nothing very remarkable was discovered, with the exception of a Danish grave stone, which was found at a depth of twenty feet below the general surface level: it bears upon one of its sides a Runic inscription, which on the authority of the Royal Society of Northern Antiquaries, may be read thus, KINA caused this stone to be laid over, or in memory of, TUKI. The date of this relic is about A.D. 1000, and it is said to be the only Runic monument known to have been discovered in London: by the side of the stone were laid the remains of a skeleton, and in the immediate neighourhood were found a great number of deer's horns cut into short pieces."

Having thus given you a rough outline, and I fear a very indistinct one of the former and of the present state of St. Paul's Churchyard, I will venture a few words upon a most interesting document in the Soane collection. It is a sketch plan for laying out the area round the Cathedral, and as there is the hand writing of Sir Christopher at the corner of the drawing, without doubt it is by Wren himself! Sir Christopher's idea appears to have been, to make the area as nearly

symmetrical as the site would admit, and to form a continuous portico in front of the houses, interrupted only by the openings to the lines of streets. At the west end, we can almost fancy that Sir Christopher had Bernini's great work in view. Sir Christopher had been introduced to Bernini at Paris, and he was so much pleased with his design for the Louvre, that he states, "Bernini's design for the Louvre, I would have given my skin for; but the old reserved Italian gave me but a few minutes view." At the western extremity of his plan, Wren has designed a circular building of some importance, the purpose of which I cannot clearly define, it appears large enough for a chapter house, but I have no doubt, that the ingenuity of some of our numerous admirers of Wren will be able to give a satisfactory solution of the difficulty. In the catalogue of 64 original drawings by Wren relating to St. Paul's now at All Souls' College, Oxford, I can find no plan which appears to resemble the one just described. To compare this most admirable plan with the wretched irregular "string and bow" space of the present Church-yard, only increases our regret, that Sir Christopher in this instance, as well as in his noble plan for rebuilding London, was obliged to give way to notions of false economy, and a mistaken idea of maintaining private rights; his plan, if executed, would have rendered London the finest city in the world. I fear no such unqualified pretensions can be made by it in its present condition.

A century has now nearly elapsed since Gwynn produced his admirable work, "London and Westminster improved;" his volume has been a guide and a text book at Whitehall as well as at Guildhall; many of his suggestions have been adopted with complete success, and I trust they may be quickly succeeded by others, for a golden opportunity, consequent upon the recently formed opening to Cannon Street, now presents itself for crowning the successful labors of the Improvement Committee of the City of London in this direction, in a manner which will confer upon them the gratitude and admiration of the whole metropolis; indeed, I may extend it to the whole civilized world, for where in the whole territory of civilization is the individual who has not heard of this "noblest of Protestant temples?"

I am very desirous that every credit should be given to that body of gentlemen, the Improvement Committee, for the satisfactory manner in which they execute the large and important matters which are intrusted to them; what has hitherto been done by them, particularly of late, is admirable. I well know the responsibilities they have undertaken, the numerous applications they have from all parties and from all quarters, and beyond all these, I am aware of the enormous sums that are required for carrying into effect great lines of new and improved thoroughfares through dense and and crowded districts. Many here present, I have no doubt, will be somewhat surprised to hear that the cost to the Corporation of London for the Cannon Street improvement, after realizing by sale the large ground rents derivable from the new and improved frontages, will amount to more than half a million sterling!

It may be all very well for some ingenious theorist in "ways and means," to say to the Corporation, "Sometime since, you succeeded in removing Crooked Lane from its former position in East Cheap to a new situation in Gresham Street West, what now more easy than to make a communication between Vintry and Portsoken, or to carry a line from St. Andrew in the Wardrobe to St. Margaret Pattens?" but, gentlemen, unless the sinews of improvement are forthcoming, all these valuable suggestions are of no avail; it is a popular fallacy to suppose that these improved lines of public thoroughfare are remunerative to their promoters, for when the sum total of the different interests, the freeholders, the leaseholders, sometimes four or five deep, the tenants in possession, the good wills, the loss of trade, the removal, and the fixtures, with 10 per cent. in addition for compulsory sale, the references, the law charges, not omitting the surveyor's charges; when, I repeat, all these items are added together, a result is produced truly astounding in its amount, and quite sufficient, I can assure you, to

test the financial skill of the Committee I have before referred to, whose great talent and ingenuity in the important matter of raising the supplies are not merely confined to the inhabitants of London, but are acknowledged, I regret I cannot say *gratefully* acknowledged, by every ratepayer within a 20 miles radius of the Post Office.

I would venture to submit to the Authorities, that there is a loftier point than a mere financial one, from which we should look upon this question. Although it may be a matter involving some fifty or sixty thousand pounds, that amount ought not to deter us from the proper completion of the most important civic improvement of modern times. Should a dry question of cost in London, of all cities in the world, prevent its citizens from displaying the finest specimen of Italian architecture the metropolis can boast of? Shall we allow it to be handed down to posterity, that the Londoners are unable to appreciate fine works of art, and noble triumphs of genius? Are we those citizens who aspire to the title of "merchant princes," and shall we yet permit our continental allies and rivals to leave us far behind, in supplying proper encouragement and resources to those who have the talent and ability to give an appropriate and magnificent character to the architecture of their country? I would implore the Authorities to put aside the paltry £. *s. d.* question, and I would appeal to them as men of *taste* as well as men of *business.* Let me urge them to this, adapting for the occasion the words of a city poet,*

"That *they* may add to London's dignity,
And London's dignity may add to *theirs.*"

They have the advantage of being assisted by a member of this body, an architect whom we all esteem, who on several occasions has successfully entwined to their delight, the blossoms of art with the fruits of commerce; and knowing well their praise-worthy veneration for precedents, I would recall to their recollection, that a few years since, when their emporium of commerce was rebuilt, they voluntarily sacrificed the site of Bank Buildings, a plot most singularly similar in size and form to the one whose freedom I am now unworthily advocating, and only differing from it in its *greater* local value. What they voluntarily acceded to their *Exchange*, surely, they cannot refuse to their *Cathedral!* And the honor they so worthily paid to their distinguished architect in the 19th, they cannot for one moment refuse to the memory of London's great architect of the 17th century!

As the day of the triumphal opening of the new street is shortly approaching, may I most respectfully take the liberty of suggesting, that on that auspicious occasion the Authorities should allow the encumbering hoarding to be removed, and the site fairly levelled?—they would then display to their applauding fellow citizens a sight by far exceeding all the elaborate pageants from the days of Walworth to those of Sidney!

I have every confidence that this appeal to the Corporation of London will not be made in vain, and that that Body on their part, and you my brother members of this Institute on yours, will generously step forward to effect the great national objects we have in view—the preservation of an open space through which the light of glorious day may shine upon the most noble Protestant temple in the world! and the dedication of a statue to testify our gratitude to its architect, that great and good man, Sir Christopher Wren!

Mr. Hardwick, Fellow, said that he must claim it as his special duty to move the thanks of the Institute to Mr. Angell for the admirable paper just read. No one had been more intimately associated with that gentleman than he had for a period of nearly forty years, during which mutual friendship

* George Peel, The Pageant, 1585.

and esteem had existed between them. He was quite sure the meeting would unite with him in expressing their sense of the attention Mr. Angell had paid to the important subject of his paper. Although they must all feel that in laying out a new city it was most important to provide open spaces, it was much more important to preserve those which existed in an old city like London; and when an opportunity occurred of leaving unencumbered such a spot of open ground as that at the south-east of St. Paul's, so as to expose to view most favourably the magnificent structure of which they were justly proud, it was essential to embrace it. Mr. Angell had been peculiarly happy in his allusion to the unfortunate attempts which had been made to fill up some of the open spaces of London. In reference to Leicester Square, they must all feel that what had been done was a perfect failure, and he would rather see it with its broken shabby railing, and its dirty trees and grass, than in its present state, however interesting the building with its contents which now occupied it. He should, moreover, be extremely sorry to see Lincoln's Inn Fields covered with buildings. If the space between that spot and the Strand were cleared away, it would afford a magnificent site for the proposed new Law Courts, without infringing on "our vacant spaces."

The Chairman, Mr. T. H. Wyatt, V.P., said it was not the first time Mr. Angell had instructed and pleased the members attending the evening meetings by his remarks, and they would, no doubt, recollect his interesting paper on the life, the genius, and the works of Vignola. Mr. Angell had expressed his regret at the departure of the primroses from Primrose Hill, but he had managed to bestrew his paper with many charming flowers.

Mr. Tite, Fellow, considered that Mr. Angell had nearly exhausted the subject in his own excellent observations, and he could only most cordially second the motion of his friend Mr. Hardwick. Quoting from memory, he believed that one of the Odes of Horace commenced with the remark, that "the town in its mighty buildings treads so heavily upon the country, that there soon will not be an acre for the plough to work upon," and he was afraid that this was really coming to pass in London. The worthy alderman now present had seen many changes, and known many, many acres covered: the fact that many fields which had been covered by the modern Babel in the recollection even of young men, and the idea of the plough yielding to the palaces of the present day became strongly impressed upon the mind, and the preservation of all existing open spaces, merely for breathing room, was therefore strongly to be inculcated. With regard to the space at the south-east end of St. Paul's, he would not pretend that it was essential for the mere purposes of health—it would be idle to seek it or to ask it on such grounds—but in a meeting of architects like the present, its importance could not be lost sight of. He fully understood the commercial value of the site, and the difficulty the Corporation would find in replacing the £50,000. or the £60,000. it might cost; but he believed they would appreciate the feeling of architects, and the immense gain, in an architectural sense, the city derived from the marvellous view which had been afforded of its great national work—a gain far greater than the mere £60,000., or any sum which could be put into the scale against it. He believed it was only necessary to appeal to the good taste of the citizens of London, and their appreciation of the magnificent view which had been thus accidentally opened, and that they would do their best to preserve it. They would thus be enabled to convince foreigners, that there was something in London worth coming to see. London was formerly a city of churches and monasteries, it then became a city of merchants' dwelling places, it might now be said to be a city of counting-houses; it was important therefore to preserve, if possible, some memorial of its former more open state. They could not boast in London of the fine architectural groupings of Berlin, Munich, Paris, and Rome, and whilst in that respect they could offer so little to the wondering stranger, appalled by the bustle of business, and the mighty interests involved in the traffic of the city, they should indeed be glad to have the space now under considera-

tion, where they might call his attention to the artistic beauty of the south and east fronts of the Cathedral, as developed by the recent improvements effected by the Corporation. Regarded in this light and supported by the interesting historical recollections adverted to by Mr. Angell, the argument, he had no doubt, would be urged upon the Corporation with great force, and they would do well and wisely to yield to the common impression on the subject, that it would be unbecoming of the spirit of the age to let such an opportunity be lost, merely for the pounds, shillings and pence view of the question, and to sacrifice what he believed would be a more valuable monument to their taste and liberality than even the new and improved communication with which it was connected. He knew so much of the Corporation of London, and of their readiness to promote improvements, that he was always willing to be their defender; and he need only refer to the state of Copenhagen Fields in former days, as compared with the skilfully planned and well executed works now being carried out there, as an instance of their public spirit. The wit and eloquence of Mr. Angell's paper deserved the warmest acknowledgments of the meeting, and he begged to second the offer of their earnest thanks for the instruction which it had afforded them.

Mr. Twining, Visitor, referred to a rule enforced by the municipal authorities of Paris, which provided, that when a house in any narrow thoroughfare was taken down, the new building should be set back 12 or 15 feet. By this means all the narrow streets were gradually widened; an object which could not be attained without the exercise of some authority. It occurred to him that of the Continental Squares, or open places, those which had no central monument or great architectural edifice, were generally architectural and symmetrical,—such as the Place de la Concorde, the Place Vendôme, and the Place du Carrousel. On the contrary, the open spaces surrounding the Cathedrals of Antwerp and Strasburg, and Notre Dame at Paris, presented no such regularity or symmetry. The Piazza of St. Mark at Venice, and the approach to St. Peter's at Rome were however exceptions, and undoubtedly the effect of St. Peter's was much increased by the beautiful access and the fountains in front of it. In the other cases it might be said that the effect of the cathedrals was heightened by their contrast with the small and irregular edifices around them. He was of opinion that space was the first requisite around a large and imposing edifice, and next to that, buildings somewhat in harmony with it.

Mr. I'Anson, Fellow, trusted that the public might always be able to contemplate the beauty of St. Paul's, as now for the first time displayed. Mr. Tite had eulogized the Corporation, but he (Mr. I'Anson) thought that on this occasion they might appeal not only to the Corporation, but also to the Government. In Paris, the municipality and the Government went hand in hand; and those who knew Paris thirty years ago and had seen it recently could testify with what success. The Rue de Rivoli was now perhaps the finest street in Europe. He believed that if the matter were properly submitted to the Government they would assist in promoting the object before the meeting, by giving to the Corporation of London the funds derived from the coal duties. The Government had already assisted in many civic improvements, and this assistance might easily be extended further. Victoria Street, Westminster, was promoted by a grant of £50,000 from Government, besides other advantages. It should be at once recognized that money extended in this way by the Government was indeed well spent; and it was most desirable that the inhabitants of the metropolis should have not one, but many architectural beauties to display to foreigners. London already possessed the finest bridges in the world, and a remarkably fine series of open squares, but it also displayed a great want of the appreciation of artistic decoration. The opening of the view of St. Paul's would refresh the eyes of passing thousands, and would tend to improve the public taste, and to promote decoration in minor objects.

Mr. Penrose, V.P., regretted he had not been able to submit to the meeting some photographs which he had directed to be taken to illustrate the subject, which indeed had been so well urged by Mr. Angell and Mr. Tite, that it was almost impossible to add anything to their remarks. Looking to the wedge like form of the space of ground in question, and considering the very great portion of the Cathedral which must be hidden by building upon it, it was of the greatest consequence to "agitate" to get it left open, if possible. The greatest difficulty both to ourselves and to foreigners in contemplating the many really fine edifices in London, arose from the fact that the traffic of the whole city was so great that there was no favorable opportunity for looking at them. Hence the opening of a moderate space in such situations as this was most desirable, as it would afford an enjoyable position for seeing the buildings and shewing them to strangers, who, if they wished to sketch, need not then be exposed to an order to "move on."

Mr. Bellamy, Fellow, could not refrain from expressing his sense of the importance of the opportunity now offered. Many non-professional men were not aware of the extreme beauty of the magnificent view which architects now sought to keep open. When he saw it on a recent occasion he was most forcibly struck with it, as the beau ideal of outline and composition. Instead of falling in with Mr. I'Anson's suggestion, he would say, let the honour be to the Corporation alone; and he was sure the city would not begrudge the sacrifice, great as it might be; the question should not be put upon the pecuniary consideration, but rather upon the honour which would accrue to the Corporation availing itself of the present opportunity. It was in contemplation, and he believed might be regarded as a *fait accompli*, that the statue of Peel should be placed at the north east angle of the Cathedral; now if a statue of Wren were erected at the south east angle, the balance of these statues would be a vast improvement to the city. He could not indeed conceive anything more calculated to elevate the minds of the people than the contemplation of the statues of so great an architect as Wren, and of so great a statesman as Peel. Every man who had read the life of Wren, must be moved by the greatness of his mind, his profound scientific attainments, and his high moral character; a lesson to all that those qualities might be combined. He therefore strongly urged upon all present the importance of the improvement in question, which they should strongly impress upon their friends, and which they might all aid in accomplishing.

Mr. Rennie, C. E., having attended the meeting at the suggestion of his friend, Mr. Penrose, had listened with great interest to the admirable paper of Mr. Angell, and the remarks which had been made upon it. In the early part of his life he had been familiar with many open spaces which were now covered with buildings. He recollected Moor Fields with its long rows of trees, and ponds between them; Old Bethlehem Hospital with Colley Cibber's "brainless brothers,"—the remnants of Ranelagh Gardens,—and St. George's Fields, with that favorite resort, the Dog and Duck; but he remembered with still greater pleasure the locality of St. Paul's School, where he had passed some years of his education, and for which he had imbibed a love that had increased with age. In youth he had been led to consult the writings of Sir Christopher Wren, and had learnt to respect him as the founder of the Royal Society, as an astronomer, mechanician, and a mathematician; and especially in that capacity in which he was best known to the meeting,—a great architect. He, Mr. Rennie, was lately walking with his brother through New Cannon Street for the first time, and was so struck with the magnificence of the view of St. Paul's which it presented, that he at once expressed his anxiety that the triangular space at the east end of the Cathedral should not be again covered with buildings. His brother urged him to write to the "Times" upon the subject; but being unwilling to bring his name before the public, he wrote to Mr. Penrose; and that gentleman had thereupon written to the "Times" the excellent letter with which they were acquainted; he

was indeed gratified that public attention had been thus called to the subject. £60,000. was but a small consideration to the wealthy City of London. Such a sum was often thrown away by them on matters of mere personal gratification; and surely they should not neglect to expose to general admiration the finest work of the greatest architect of this country. This was an object worthy of the Corporation of the City of London,—they alone should take up the subject, and the honour of it should be theirs alone.

Mr. Piper, visitor, expressed his admiration of the ability which the paper and the discussion had manifested. He ventured to say to the members of the Institute present, that from them the public ought to learn that their daily footfall was on ground of historical interest, and that they had amongst them monuments which such efforts as the present on the part of the Institute would shew them how best to see and enjoy. The Institute could have no more honorable task than to convince the public that they possessed in this metropolis architectural works of the highest value, and that it was their duty to preserve and appreciate them.

Mr. Donaldson, Fellow, observed that there could be but one opinion amongst architects and men of taste upon the question. It had been said there were few points of architectural interest in the metropolis; but one had been forgotten, which he (Mr. Donaldson) regarded as amongst the finest which the world could present. Looking from the east end of the Poultry towards the Royal Exchange, with the Bank on the left, the Mansion House on the right, and the beautiful church in Lombard Street in view, an architectural group was displayed which he believed could not be surpassed in any other city. He trusted the Corporation would not lose the present opportunity, especially as that body included many men of taste; while apart from the question of architectural effect, he felt the great practical importance of this improvement in connection with its facilitating the access to the Railway Stations at London Bridge, now so much impeded by the crowded state of the streets. The advantage, in this point of view, of opening the space in question, would be at once seen by reference to the plan. With regard to the cost, it should be borne in mind, that if carried out, the improvement would always redound to the honour of the Corporation, whereas, if neglected, it would be a lasting reproach to them that they had the opportunity, and that for the paltry sum of £60,000. it had been thrown away. If once again built upon, the space could never be cleared again. It was comparatively a new feature in the thoroughfares of great cities that instead of being directed as formerly to the great entrances from the immediately surrounding country, they should be directed towards the principal railway termini. In Paris the Emperor had ordered the construction of a road 100 feet wide to the Strasbourg Railway Station, and so the Corporation should by every means promote the access to the Stations at London Bridge. In Glasgow and in Edinburgh the houses in the principal streets must all be faced with stone,—in New York a magnificent city was rising, with elevations of granite or of marble, and London should not be backward in the march of improvement. In the present question their opinions, as architects and men of sound practical sense, were unanimous, and he trusted the thoroughfare nobly commenced and carried on with so much credit by their friend Mr. Bunning, would be rendered complete by the preservation of the vacant space which had led to so much interesting discussion.

The Chairman conveyed to Mr. Angell the thanks of the meeting, and the proceedings closed.

ON THE DRAINAGE OF BUILDINGS AND STREETS IN THE METROPOLIS.

Being a Discussion (in continuation) held at the Ordinary General Meeting of the Royal Institute of British Architects, May 15, 1854.

The Chairman, Mr. F. C. Penrose, V.P. stated that it was necessary the discussion should be concluded that evening, and that in conformity with the wishes expressed at the last Meeting it should be confined as far as possible to the question of outfall, which had not yet been discussed. Although not immediately connected with their duties as architects, this branch of the subject was of very great importance, and there was ample room for a discussion of it with reference to scientific principles.

Mr. Fowler, Fellow, observed that the removal of sewage from the houses and conveying it under the streets had given rise to much interesting discussion at the former meetings, and although opinions might differ as to the best modes of doing so, there existed much greater activity and efficiency in house and street drainage than at any former period. But what was the result? The more that filth was drawn off from houses and streets, the more it was thrown into the Thames to pollute the stream and render it a source of annoyance and pestilence to the inhabitants along its banks. The offensive state of the river and its shores was a matter of notoriety. It had been urged that the body of water in the river was so large as compared with the sewage flowing into it, that the latter was so diluted as to be inoffensive, but the experience of their senses was sufficient to refute this assertion. In fact the offensive matter being lighter than the main body of the water floated upon the surface, and as it was not conducted into the main stream, it remained near the banks, where the velocity of the current was much less, and with the ebb of the tide it was deposited upon the shore. This matter, so offensive to the senses and so injurious to the health, was in itself valuable, and if it could be applied to the land as a fertilizing agent, its value would be incalculable. Various schemes had been proposed for accomplishing this object, especially one which in a commercial sense had been a failure, although it had so far succeeded as to shew that the sewage water might be dealt with in the above manner if the proper means were applied, and if the matter were taken up as a public measure rather than as a private speculation. Other modes had been suggested, and sewage manure had been manufactured in a solid form, but these had all been failures. At the present time Mr. Wicksteed, the Engineer of the East London Water Works, was engaged in a very large speculation of this kind at Leicester, by which he hoped to obtain the offensive but valuable matter from the sewage when collected in reservoirs, and to leave the water pure. He, Mr. Fowler, looked with much anxiety and interest to the result of this experiment, especially with reference to the possibility of its application to the metropolis, but he had some misgivings as to its success. Another plan which had been proposed was that of conveying the sewer water direct by main pipes into the country, and then distributing it over the land; and in many instances liquid manure had been so applied with most beneficial and profitable results. With respect to the views of the Government, to whom the decision of the question must eventually come, Lord Palmerston had declared that they would consider no general plan for the drainage of London effective which did not provide for saving the river from pollution, and at the same time preserving the products of the sewage for fertilizing the country. If this were the right principle, it was obvious that the sewage should be carried by the shortest and most easy courses into the country direct, and therefore the majority of the plans proposed, suggesting as they did the concentration of the sewage at a spot some distance down the river, had a tendency to obstruct that principle, and were therefore unadvisable. These plans too still made the Thames the receptacle of the sewage, and he (Mr. Fowler) believed that even from below Greenwich

it would be carried upwards by the flow of the tide as far as Hammersmith. It would in fact be kept floating up and down with each tide, and would only get half a mile lower down at each ebb. Thus both of the principles laid down by Lord Palmerston would be violated. The subject was one of great importance, and it had not escaped the attention of the Government. He had great apprehensions that the plans hitherto proposed, although emanating from gentlemen of great talent and authority, would hardly fulfil the objects intended, and he was therefore anxious that the subject should be fully discussed, in order that some plan likely to ensure satisfactory results should be adopted.

Mr. Morewood, representing the Great London Drainage Company, stated that the question before the Meeting was the "outfall" for the drainage of the Metropolis, and as the Board of Health plan dispensed with all the present arrangements, and consequently with the necessity for an outfall, it might be well to say a word in reference to their plan, as recommended by Mr. Fitzroy to the Metropolitan Commission of Sewers, which had been ascertained to be identically the same as that which the Sanitary Commission advocated in 1848. It consisted of "liquid distribution of sewer water," of "pipe sewers" and "pipe drains." Liquid distribution had now been advocated for ten years, and was specially in favour in Greek Street in 1849, and yet up to this time there was not one instance of its being used in any one of the towns under the Board of Health. In fact he declared it to be entirely fallacious, and that it never could be carried out profitably. As to pipe sewers; Sir Christopher Wren built a sewer 20 inches by 14 from Cripplegate to Bridgewater Square in 1691, and in 1714 it had to be taken up and rebuilt 4 feet by 2 feet. Mr. Kelsey, the late very able surveyor to the City Commission of Sewers stated, "it is not in the least improbable that, if drains and sewers are so wire drawn as barely, and that with the most unremitting attention to their cleanliness, to suffice for the ordinary discharge of the foul waters of houses, and of ordinary showers of rain, another generation will not pass away before another re-modelling of such matters will be found imperatively demanded, as one may with tolerable certainty predict that if sewers should be built into which a man cannot get to examine and repair as time shall gnaw them away, the evil day must and will come when the whole will have to be re-constructed." In reference to reducing the optional sizes of house drains to 12 by 9 inches, he said, "with what advantage or detriment time will shew," and the very words which he used in respect to stoppages and failures, were the same as those used in a report from the Board of Health in reference to Croydon. "In cleaning the obstructed sewers, however, it has generally been found that the stoppages, whether in 4 or 6 inch pipes, have occurred from substances which ought never to have gained admittance to the sewers at all. From Mr. Simpson's evidence in 1846 it appeared that the Chelsea Water Works Company had laid down a quantity of earthenware pipes, which after a few years had a dull sound when struck, and when they burst might be crumbled with the hand. At Croydon some of the pipes were found to have become softened, and there was moreover the Metropolitan Commissioners' report of failures, with a vast number of illustrations. The Board of Health plan of liquid distribution of sewer-water of pipe sewers and drains was therefore entirely inadmissable.

The recognition of that which the Metropolis requires, a lower outfall than the Thames, was to be found in a pamphlet in 1839, emanating from an architect, who, after shewing the existing levels in Westminster, states that it is quite impossible for the Commissioners of Sewers to remedy the evils complained of. They had for years past endeavoured to palliate the mischief; all the sewers in Westminster for twelve hours out of the twenty-four were merely cesspools or reservoirs, the mouths being closed by sluice gates; indeed, were it not for these gates every house in Westminster, even those in Park Street and James Street, would at high tides be inundated with the filthiest of floods. In 1846 Mr. Donaldson gave very decided evidence in reference to the inefficiency of the present outfall

into the Thames, and showed how readily the Westminster Commissioners of Sewers were availing themselves of the temporary lower outfall caused by the removal of old London Bridge; and in 1847 Mr. Wm. Hosking in a postscript to his work, strongly warned the Government against further clogging the sewers and the Thames, "unless the refuse can be certainly hurried on through the sewers, and in a diluted state to an *effective outfall*." Mr. Simpson, when asked in 1851, "If water be not drawn for domestic purposes below Hammersmith Bridge, do you see any objection to the Thames continuing the means of drainage to the Metropolis," replied, "Yes, I do. I think it would be the greatest gift to the Metropolis if we could convey the sewage lower down." This lower "outfall," this removal of the sewage Mr. Morewood considered could alone be effected by the drainage plan with which he was connected, commonly known by the name of the Great London Drainage, which consisted of two tunnel sewers extending on each side of the Thames respectively, from Chelsea and Vauxhall to the marshes east of London, the sewers running under the streets and roads, as the Strand, Fleet Street, &c., to be made by tunnelling, and to be laid with an artificial or additional fall, so that the sewage might be passed away from the Metropolis and pumped up at the terminal works, there to be formed into a dry manure, the refuse water being thrown on the top of the tide. He stated that this drainage plan had been prosecuted in the session of 1848, when it had been very favourably entertained by the Government, but it was most unexpectedly stopped at the second reading on the 7th March, 1848. In 1853, the proposed works and estimates had been proved before a Select Committee of the House of Commons, and the minutes of evidence printed by the House, with a view to future legislation, and the chairman of the Committee had stated to the House, that *they had fully approved* of the works proposed, viz. two tunnel sewers to deliver the refuse below the town. In reference to the Metropolitan Commission of Sewers, Mr. Morewood stated that their own report to Parliament in 1851, fully identified them with these very works; the tunnel sewer on the north side being described as from Chelsea "to the pumping station on the river Lea," and that on the south side as "a system of sewers between a point near the top of Woolwich Reach and Vauxhall, the main line and branches comprising upwards of thirteen miles." A report from the surveyors of the Metropolitan and City Commission of Sewers entirely approved of the line of those sewers as proposed by the Great London Drainage Company, declaring in reference to the north side that it was in some respects better than the alteration adopted by the Metropolitan Commission (in 1851); and respecting the south side, "the general levels of the district, as well as the levels of the inverts of its sewers are such that the interception of the sewage can be effected by either scheme." Respecting high level sewers, by which the question has since been complicated, they expressly said, "and it would in our opinion be found necessary at some future day to construct upper lines of intereepting sewers.

The point of difference with the Commissioners was the guarantee of a contingent interest of three per cent. for twenty-five years; and also the Commissioners not having taken into their calculation that the tunnel sewers were never intended for Richmond and Croydon; that evaporation amounted to thirty-two inches when the rainfall was twenty-seven inches; that absorption materially reduce the quantity of rain water to be provided for by tunnel sewers; and that immense storage room was already in existence for storm waters, which would pass through the present channels into the Thames, when the quantity of ordinary sewage, ten or twelve million cubic feet, exceeded the thirty-seven millions for which the two tunnel sewers provided.

Mr. G. R. Burnell, C.E., in reference to the deodorizing of sewage water, alluded to the works which had been carried on at Cardiff, and said that Professor Way had informed him that there was a great difference between the sewage water of large and of small towns, and that the sewage of London when it had passed through great length of sewer, and arrived near the outfall, had lost so

much by evaporation that it contained very little indeed of really valuable matter available for agricultural purposes. Seven years ago he had visited the works near Chelsea referred to by Mr. Fowler, and although they had been highly eulogized at the time, he found that they did not distribute sewage water at all, but merely the water from a canal.

Mr. Fowler explained that that had been the case only in the commencement of their operations, the main was afterwards laid into the well.

Mr. Burnell said the fact was as he had stated it even more recently.

Mr. Fowler said that Mr. Burnell had been misinformed. In 1852 the company distributed a great quantity of sewage water.

Mr. Burnell considered the general question to be purely of an engineering nature, and that the Home Secretary was travelling out of his path in deciding that an uniform system should prevail, when in fact nothing was clearly known upon the subject, and scientific men declared that the sewage of small towns was fit to be profitably used, whilst that of large towns was not.

Mr. Fowler believed that the Government merely asserted a general principle which did not involve any engineering question. It was simply a question of economy, and one that might be properly taken up by the Government. They had not gone so far as to dictate any particular mode of carrying out their principle. Mr. Fowler added that the discharge from the King's Scholars' Pond sewer had been found to possess fertilizing qualities in a very high degree.

Mr. Haywood, C. E. observed that the question of outfall hinged entirely upon the question of the value of the sewer water. If it could be proved that manipulating the latter would pay five or six per cent. small manufactories might be established at the mouth of every sewer, but unless it could be made to pay it would not be so dealt with. If the drainage was not to flow into the Thames intercepting sewers were necessary; and if though flowing into the Thames its reflux was to be prevented, then it should of course be carried sufficiently low down to prevent its returning with the tide. With regard to irrigation with sewer water he had no doubt of its advantages, but he much questioned whether it could be made to pay. The mode of draining towns should be regulated by natural and local features. In country towns it was natural to attempt the distribution of the sewage in a liquid form, and where a town was drained into a beautiful trout stream, it should be a *sine quâ non* that something should be done to get rid of the sewage before it polluted the water, whether the means adopted paid or not. The magnitude of the drainage of London (amounting as it did, without a drop of rain, to twelve millions of cubic feet of water every twenty-four hours) was a serious obstacle to any purifying scheme, but even that would be surmounted if it would pay five per cent. The late John Martin was the first to originate the idea of intercepting sewers; he was followed by Mr. Foster, Sir Wm. Cubitt and many others, and lastly by Mr. Bazalgette and himself. Their plan had no particular novelty, but they believed it was the best that had been laid down; they considered that the great fault in the plan of the Great London Drainage Company was that it was not sufficiently comprehensive, and did not allow for the extraordinary influx of storm waters. A scheme of this kind should be available for the next thirty years at least, and not be liable to require reconstruction in every ten years; they also objected to the pumping on Mr. Morewood's plan, preferring drainage by the natural force of gravitation as a cheaper system, and one not so liable to accidental interruption. Mr. Fowler was in error as to the effect of the tide upon the sewage, if admitted into the Thames some distance below London. The plan of Mr. Bazalgette and himself was that the sewage should be discharged, say at Woolwich, only with the first two or three hours of the ebb tide, and in that case none of it would return so high as the point at which it was discharged. He did not believe that the Thames was polluted to the extent that was generally supposed, but as the population was so rapidly

increasing, and would probably amount to five millions in thirty years, the river would certainly not be improved in that time. The sewage was an infinitesimal quantity compared with the water of the river, and was far less injurious than the public imagined; four minutes of ebb tide at London Bridge would suffice to carry down all the real fecal matter of the twenty-four hours, if collected together, and much of the effluvium which arose at low water was in consequence of the sewers discharging their contents upon the shore, instead of being conveyed by culverts to parts below low water mark. Mr. Haywood repeated that the whole subject turned upon the value of the animal matter contained in the sewage, and he should consider £50,000 well spent in determining the value of this matter when relieved of seven hundred times its bulk of water. All the illustrations of its value had been drawn from places where its dilution was not one-third or one-sixth so much as in London. Thus at Edinburgh the valuable matter was so highly concentrated that its distribution over the surrounding meadows had become a fearful nuisance, but it had been argued that in London all the smell would be lost in two minutes and a half.

Mr. Austin, Visitor, produced a drawing of his proposed plan of Sewerage, which consisted of a large tunnel below the streets, providing at the same time space for gas and water pipes, and containing a tramway for connecting the different railway stations. He also produced a plan of drainage by means of two tunnels under the bed of the river on each side. He proposed that only the flood or rain water should pass directly into the Thames. Mr. Austin alluded to a plan of deodorizing sewage water, and rendering it so pure that it might be drunk. He urged that the fertilizing properties of sewage manure had been clearly proved at Glasgow. In reply to the Chairman, he stated that he had not made any estimate of the cost of his project, and that the size of his tunnel was 26 feet in height by 18 feet in width. He did not consider this too much, looking to the increase of population; on the contrary, he considered all the existing sewers were much too small. The value of the sewage running to waste in the river was incredible, but some idea of it might be formed when he stated that six crops of rye had been obtained in one year by using sewage water. Hence he felt assured that sewage matter, properly collected, would pay a proper return on the outlay.

Mr. Garling, Fellow, said it was a question whether deodorizing sewage did not spoil its agricultural purposes; and, moreover, he believed that although mechanical purity could be obtained, chemical purity could not, and that however pure, apparently, such water would be unfit for ordinary purposes. The organization of a general system of sewerage was properly the duty of the Government: but if it could be made to pay, which he very much doubted, he believed it would be better carried out by private enterprise. The question of the proper course for the outfall must depend on a system of levels very accurately laid down. In reference to Mr. Haywood's statement, that Mr. John Martin was the first to originate the idea of intercepting sewers, Mr. Garling read an extract from a letter written by himself in 1824, referring to a project which he had put forth ten years before. This shewed that he (Mr. Garling) had really proposed intercepting sewers before Mr. Martin did so, and that his views at that early period were similar to those of Messrs. Bazalgette and Haywood.

Mr. Morewood observed that a very similar plan had been suggested by Mr. Dodd fifty years ago. He stated that the Great London Drainage Company contemplated the formation of high-level sewers in addition to low-level sewers, as the size and population of London increased, and that their plan was fully adequate to provide for the ordinary rainfall in the metropolis.

Mr. Boulnois, Associate, begged to make a few observations by way of general reply, not limiting his remarks to outfall only. He had stated in the paper which had led to this discussion, that all the plans proposed were so expensive in their nature as to preclude the possibility of their being carried

out. Of all the plans that of Mr. M'Lean was, perhaps, the most feasible. It appeared that all parties were agreed that the outfall should be at some point low down the river, that the expense should be modified as much as possible, and that the details must be left to those engineers who were capable of carrying them out. On the question which had been first raised, namely, the merits of pipe sewers and brick sewers, it was remarkable that, with the exception of a pipe manufacturer, not a single advocate for pipe sewers had come forward. Some gentlemen had said that they adopted them for cheapness only; but not one had said that a pipe was better than a brick sewer. As the advocates for brick sewers had thus thrown down the gauntlet, which had not been accepted, it must be taken that they were all agreed that when the cost was the same the brick sewers were to be preferred.

Mr. Rawlinson, C.E., expressed his dissent. He had been absent from London at the time of the former discussion, but if another evening could be devoted to the subject, he pledged himself to meet the objections to pipe sewers.

The Chairman suggested that Mr. Rawlinson should at once dispose of the subject.

Mr. Rawlinson proceeded to say that in reference to outfall, it was a question for practical engineers. He begged to caution the public against tunnel sewers for conveying sewage at a great depth, perhaps twenty or thirty yards below the surface, and then pumping it up again, a plan which he considered most objectionable. Its cost, moreover, could not be estimated; and it might be ten, fifteen, or twenty millions. The Victoria Sewer was estimated to cost £ 15,000., but he believed it had cost double or treble that sum. With regard to pipes, he could not fully enter upon that point; but would say that he had sewered entire towns on the pipe system, which had since been in use twelve or eighteen months, and he would stake his professional character upon those works. Four years ago he was sent for by Lord Grey to remedy the defects of a brick sewer, 5 feet high and 3 feet wide, which ramified under his house in Northumberland. He substituted for this earthenware pipes 6 inches in diameter (with asphalted canvass wrapped round the joints), and those pipes had effectually carried off the soil refuse, roof refuse, yard refuse, &c., ever since, without the slightest annoyance, stoppage, or breakage. He was now, in conjunction with the Duke of Northumberland's architect, revising the drainage of Alnwick, which town, as well as Morpeth, was entirely drained by pipes.

Mr. Boulnois must state that it was against pipe *sewers* in streets, not against pipe *drains* in houses, that he had mainly directed his observations. He did not consider Morpeth and Alnwick, where one house in six or eight drained into a small pipe *sewer*, at all satisfactory as evidence in favour of the pipe system. It was clear, from the former discussion, that in the metropolis pipe *sewers* had failed. Mr. Bazalgette and Mr. Haywood admitted this, and the latter gentleman had given an instance of failure in Leadenhall Market which he was unable to account for. The advocates of pipes had had seven weeks for consideration, and he looked upon it as nothing more than a *ruse de guerre* for them to come forward at the last moment, and to say that if they had the opportunity they could say a great deal in favour of the system.

The Chairman was sure that, on consideration, Mr. Boulnois would qualify this remark. They had now reached the usual hour for adjournment, and the discussion, which had extended beyond the usual length, must be brought to a close. Much interesting information had been elicited, and it only remained for the Members to return a vote of thanks to the many gentlemen by whom it had been so kindly afforded.

The vote of thanks was carried uanimously, and the meeting adjourned.

Correction in the discussion of April 3rd, 1854.

Page 106. The last sentence should read thus:—The original supply of water from Coombe is conducted through a main pipe under the River Thames, and the other source of supply is known as the Longford River; both these services are maintained to the present day in perfect order.

ON SOME RECENT DISCOVERIES AT FOUNTAINS ABBEY.

Extracts from Letters forwarded by the Earl de Grey, President, read at the Ordinary General Meeting of the Royal Institute of British Architects, May 29th, 1854.

Ripon, January 1854.

My Lord,

I have to apologize for not writing earlier respecting the interesting excavations now in progress at your Abbey of Fountains, but I have been waiting until the works had progressed as far as the middle transept; because, according to the MS. Chronicle deposited among your Lordship's archives, it appears that most of the Abbots, *after* the year 1435, were buried in the transept, or at the east end of the nave. However, as yet the excavators have only uncovered two tombstones, one of which (that of Abbot Ripon, 1435) we had seen in the partial openings that took place in 1841.

To give the clearest idea that I can, I will detail in order the result of the discoveries in this present excavation, commencing with the west gateway, through which the railway had to be cut, in aiming for the great west door of the Abbey church.

First, on the south side of the gateway a large room (No. 1 on the plan) not yet of course thoroughly cleared, with strong marks of fire on the floor, and an immense quantity of ashes, as if the place had been burnt down; an "Early English" bracket of one of the groining ribs is one of the most beautifully simple and elegant I have ever seen.

Two or three different levels exist in the space between the gateway and the west door of the church; this is called in some of the records *the first Court;* it appears to have been paved with cobbles.

No. 2 on the plan marks the site of the porch (15 feet wide from west to east) hitherto totally unsuspected; it is of later date than the nave, being apparently "Early English," of a period just subsequent to the date of the Lady Chapel (A.D. 1245);* the date of the nave, with its massive pillars, is between 1140 and 1156; the fragments of the porch denote it to have been of a very novel design, but of course the space it covers cannot be thoroughly cleared until the excavations in the church are finished.

No. 3 marks a tombstone without the slightest trace of brass or inscription; it is a fine large stone nine feet long, with a border of plain Tudor tiles round it; the position is peculiar—the head of the stone being close to the *west* wall of the north transept; whereas the general feeling and custom were to have the foot of the grave as near as possible to the east portion of the part of the building in which a person was buried. May this stone have covered Abbot Thirsk—one of the rebels in the insurrection of the "Pilgrimage of Grace," who suffered at Tyburn, but whose body was brought back to Fountains for interment? Or is it the grave of the great architect of the tower—Huby?

* Since this porch or "Gallilee" has been thoroughly cleared, I find that I am only *partly* right in referring its date to a period subsequent to 1245. The base of the doorway, and the fragments of dog-toothed early English caps and arches only show that extensive insertions and alterations have taken place subsequent to 1245. *The original structure was Norman, of a date very little later than that of the nave itself.*—say circa A.D. 1170, or 1180.

who might consider that the buildings he had caused to be reared were quite sufficient to perpetuate *his* name, without a tomb richly inlaid with brass, or gorgeously carved.

No. 4 marks the large *blue marble* slab which covered Abbot Ripon (1435); it has been richly inlaid with a brass figure of the abbot, two shields of arms, a mitre, a canopy, and a very long inscription surrounding the whole. It was much broken, but it has been admirably set straight and repaired under the instructions of Mr. Mason.

No. 5 marks the site of the "Early English" base of a Holy Water Stoup, near the entrance from the Cloister Court.

No. 6 (in the Chapel of St. Michael the Archangel) is the most perfect relic yet found of the coloured pavement laid down by Abbot John de Cancia (1220-1246-47); it is a copy of a pattern at Sawley Abbey, though differently arranged. All the pillars of the choir have been pulled down to their foundations, except those numbered 7, 8 and 9 on the enclosed plan. Fifteen feet east of Abbot Ripon's tomb is the platform of the choir with an ascent of two steps.

Nos. 10, 11, 12, 13, 14 and 15 on the plan mark the bases of six of the nine altars of the [so called] Lady Chapel, the other three being under the east window. I would respectfully suggest the propriety of re-opening the aumbryes (or plate closets) of these altars, which appear to have been walled up in Mr. Aislabie's time. One of the piscinas of these chapels, discovered close to the remains of its altar, shows that the majority of them were of the same character as those at Jervaulx, and *fixed in the floor*. The first chapel at the south end had once a fine large piscina *fixed in the wall*.

A fragment of a gravestone turned up in the rubbish of the south transept is inscribed, "Orate pro a'i'a;" I hope more of this stone may be found; it is of limestone—date late in the fifteenth or early in the sixteenth century.

Abbots Darnton and Huby (1479-1526) appear to have repaved portions of the transept and nave with tiles of the same pattern as those found in the Hall of the Abbot's house: one has the arms of the Abbey—three horse shoes—surrounded by that beautiful and appropriate inscription, "Benedicite Fontes domino;" the other has a Mitre and a Crosier on a shield, impaling Huby's initials M. H., and his favourite inscription, so frequently repeated on the tower, "Soli deo honor et gloria."

As many of these tiles have been severely burnt, apparently by large fires kindled on the floor of the nave and transept, and as the earth in several places is quite black with ashes, I have no doubt but that when the abbey was pillaged, great bonfires were made of the wooden lattice work and screens, and the lead of the roofs was melted into "pigs" for more convenient carriage. A passage in a curious letter published by Sir Henry Ellis is highly illustrative of this idea, and gives a complete picture of the destruction that took place at the dissolution of the Monasteries.

The writer, who lived in Yorkshire, says, "it would have made a heart of flint to have melted and wept to have seen the breaking-up of the house, and their sorrowful departing; and *the sudden spoil that fell the same day of their departure from the house.* And every person had every thing good-cheap, except the poor monks, friars, and nuns, that had no money to bestow of anything, as it appeared by the suppression of an abbey, hard by me, called the Roche Abbey; a house of white monks, a very fair-builded house, all of freestone, and every house vaulted with freestone, and covered with lead (as the abbeys was in England, as well as the churches be). At the breaking-up whereof an uncle of mine was present, being well acquainted with certain of the monks there; and when they were put forth of the house, one of the monks, his friend, told him that every one of the convent had given to him his cell wherein he lied; wherein was not anything of price, but his bed and apparel, which was but simple and of small price; which monk willed my uncle to buy something of him, who

said, 'I see nothing that is worth money to my use.' 'No!' said he, 'give me ij$^{d.}$ for my cell door which was never made with v$^{s.}$' 'No,' said my uncle, 'I know not what to do with it' (for he was a young man unmarried, and then neither stood in need of houses nor doors). But such persons as afterwards bought their corn and hay, or such like, found all the doors either open, or the locks and shackles plucked away,* or the door itself taken away, went in and took what they found, and filched it away.

"Some took the service books that lied in the church, and laid them upon their waine-coppes to picce the same; some took windows of the hayleith and hid them in their hay; and likewise they did of many other things; for some pulled forth the iron hooks out of the walls that bought none, when the yeomen and gentlemen of the country had bought the timber of the church. For the church was the first thing that was put to the spoil; and then the abbot's lodging, dorter and frater, with the cloister, and all the buildings thereabout within the abbey walls; for nothing was spared but the ox-houses and swine-cotes, and such other houses of office that stood without the walls, which had more favour showed than the very church itself; which was done by the advice of Cromwell, as Fox reporteth in his book of Acts and Monuments. It would have pitied any heart to see what tearing up of the lead there was, and plucking up of boards, and throwing down of the spars; and when the lead was torn off and cast down into the church, and the tombs in the church all broken (for in most abbeys were divers noble men and women, yea, in some abbeys, kings, whose tombs were regarded no more than the tombs of all other inferior persons; for to what end should they stand, when the church over them was not spared for their cause?) and all things of price either spoiled, carped away, or defaced to the uttermost.

"The persons that cast the lead into fodders plucked up all the seats in the choir, wherein the monks sat when they said service, which were like to the seats in minsters, and burned them, and melted the lead therewithall, although there was wood plenty within a flight-shot of them, for the Abbey stood among the woods and the rocks of stone, in which rocks was pewter vessels found that was conveyed away and there hid; so that *every person bent himself to filch and spoil what he could, yea, even such persons were content to spoil them that seemed not two days before to allow their religion,* and do great worship and reverence at their mattins, masses, and other service, and all other their doings, which is a strange thing to say, that they could this day think it to be the house of God, and the next day the house of the devil; or else they would not have been so ready to have spoiled it.

"For the better proof of this my saying, I demanded of my father, thirty years after the Suppression, which had bought part of the timber of the Church, and all the timber in the steeple, with the bell frame, with others his partners therein (in the which steeple hung viij. yea ix. bells; whereof the least but one could not be bought at this day for xx$^{li.}$ which bells I did see hang there myself more than a year after the Suppression), whether he thought well of the religious persons and of the religion then used? And he told me yea; for, said he, I did see no cause to the contrary. Well, said I, then how came it to pass you was so ready to destroy and spoil the thing that you thought well of? What should I do? said he. Might I not, as well as others, have some profit of the spoil of the Abbey? for I did see all would away, and therefore I did as others did. And thus much upon my own knowledge touching the fall of the said Roche Abbey."—*MS. Cole, vol. xii. Ellis, III. iii.* 35.

* It may not be uninteresting to state that the late Ralph Tinsley, of Fountains—for many years the burly blacksmith at Studley Hall—purchased of his predecessor, or his executors, a great quantity of old iron—door hinges, staples, and crooks—which the said predecessor had wrenched from the Abbey walls. Ralph used to declare that it was the toughest iron *he* ever worked up.

Ripon, February 16th, 1854.

Shortly after writing the letter in January a few curious discoveries caused me to delay sending it, in order that I might forward additional information.

The rest of the gravestone beginning "Orate pro a'i'a" has been discovered in the south transept (No. 16 on the plan). The inscription, in fine black letter, shows it to have covered the remains of Brother John Rypon "Fr'is Joh'is Rypon," a monk I suspect, and not the abbot of that name. Unfortunately the portion of the stone that would have furnished us with the title and dignity of "Brother John" is broken. The date, too, is gone, except the name of the month (March), and the last figure of the year of our Lord . . . 4.

I have since discovered, after a minute examination of the base of the Holy-water stoup, (No. 5 on the plan) that its marble basin is *now used as the Baptismal Font in Aldfield Chapel.* It is most beautifully carved, and is evidently the work of the marble-mason of the Abbey during the erection of the choir and Lady Chapel (1204, 1245), who is styled in the charters of *that date*, "Thomas, Marmorarius de Sawley."

A screen once crossed the nave from pillar to pillar (No. 17 on the plan). In a space in the thickness of this screen a very curious discovery has been made, viz.—A number of large earthenware jars laid on their sides, and embedded in the base of the wall, a very few inches below the level of the floor. They were filled with charcoal ashes, but at present it has puzzled us all to discover their use. I hope shortly to be able to send a drawing of the place, and a correct sketch of one or more of the jars.

At the west-end of the nave, and a few feet in front of the pillars, we have found one or two of the *processional* stones.* They are of Morkar limestone, about 2 ft. 3 in. square, with a ring lined out in the centre. On these stones the Abbot and brethren arranged themselves prior to proceeding to perform service in the Choir. The stone on which the Abbot stood was *in the middle, at the west end*, only a few feet from the *west door*. Similar stones were formerly visible at the west-end of the nave of York Cathedral.

Bases of stone altars have been discovered fixed to the pillars of the nave. Two pillars have brackets for the images of the Saints to whom these altars were dedicated. One altar (no doubt a wooden one) was placed on a small platform of tiles a foot higher than the floor of the rest of the Church.

But the most curious discovery of all is the existence of a "Galilee" or west porch (No. 2 on the plan). To our astonishment we found that this porch had occupied the whole breadth of the west front (70 ft.). I suspect from the remains of the architectural fragments that it had a series of interlacing arches, with double shafts, and that this arcade was always open to the air. The wall would be about 4 ft. high to the bases of the columns supporting the arches and its superincumbent structure. At the south-end of this porch are five coffin slabs—the cross-heads on three are missing, the other two are plain, excepting their slightly moulded edges. At the north-end are two coffin-slabs —the first is plain, the other, close to the north wall, is the most perfect yet discovered. The device it bears is a processional cross of the patée form, enclosed in a circle. It is in its original position on the stone coffin, and firmly fixed with metal cramps.

* A minute investigation has since shewn that the processional stones at Fountains are *fifty-two* in number. They range in two straight lines seven feet distant from the bases of the nave pillars—the pathway between them being 12 ft. 8 in. wide. The cross-bearer's stone is in the middle, at the east end of the range, *ninety* feet distant from the Abbot's standing place.

In this porch, nearly in front of the great west door, was found the prostrate and mutilated figure of

"The Virgin Mother of the God-born Child."

The Abbey was dedicated to the Virgin Mary. It is but the remains of a fine statue—the head gone, and the figure of our Saviour nearly all broken off. I have no doubt it occupied the now vacant niche above the great west window. This window was *inserted* by Abbot Darnton between March and May, 1494, and the figure of the Virgin is of the same date.

It is useless to expatiate on the wonderful effect this last excavation has given to the appearance of the interior. It is quite marvellous. In fact the Abbey is now another place altogether. The opening of the great staircase, from the nave to the monk's dormitory, has given a fine effect to that portion of the church to which it is attached.

In clearing out the undercroft of the vestry (No. 18) the bones of more than 400 skeletons have been found piled in a somewhat regular order. This place was always called the "*Bonehouse*" by the old guides, but I feel certain the deposit is subsequent to the dissolution of the Abbey (A.D. 1539).

An opportunity could now be taken to get casts of two small, but beautiful statues in the tower, as well as the Angel on the fine canopy, holding a shield with Abbot Huby's initials. This last carving is important, as it fixes the date of the tower, and I am afraid that both it and the figures (being cut in limestone) are beginning to suffer from the effects of the weather. I would suggest that all these casts, after the sketches are taken, should be deposited in the Museum, which I understand is to be formed in the "*Hall of Pleas*"—the dry groined room over the kitchen.

Ripon, 17th March, 1854.

My Lord,

Capt. Smith has favoured me with a perusal of your note respecting the singular rude vases or pots found at Fountains. The drawing (by Mr. H. W. Todd), the plan and the section herewith forwarded, will, I trust, be found sufficiently explanatory of the position and appearance of these very curious objects.

The wall in which the pots are deposited is, evidently, the base of a passage in the thickness of the old screen, which might be entered by a doorway in the side wall of the entrance through the screen; the floor being a step or two below the general level of the Church. There is a small room in the thickness of the choir screen at Ripon Minster, on the north side—the similar space on the south side being occupied by the stone staircase leading to the organ loft. The screen in the Church at Fountains, not only crossed the nave from pillar to pillar, but it also occupied the space of the last arch of each *side aisle* of the nave. The pots or vases are laid in the wall on their sides, embedded in mortar. The depth of each vase is from 12 to 14 inches; the diameter across the widest part, 10 inches; the mouth 6 or 7 inches diameter. The necks of those in the west wall protruded slightly from the masonry; those in the north wall, when perfect, projected a little further.

The presence of the charcoal in and around the vases will not, I fear, assist us in coming to any conclusion as to the real use of them. For the charcoal found here filled nearly the whole of the space No. 1 on the plan, and may have been the embers of the fires (fed by the stalls and other lattice work) when the lead was melted at the dissolution of the monastery. Charcoal was also observed on several parts of the floor of the nave. Cinders were also found *in very small quantities*, mixed with charcoal in large quantities, in the pots

or near them. It may be well to remark that the whole of the depressed space in front of the wall in which the pots are embedded, was filled with charcoal. It is my opinion that the charcoal has nothing to do with the purpose or use to which the pots have been put. We know, from written record, that the lead from the roof at Fountains was melted into "*pigs*," and the remains of a small furnace, (*evidently post-reformation work*) were found, in making the recent excavations, attached to one of the pillars of the nave, *near* to the place where the pots were discovered. In fact, charcoal was found strewed in large and small quantities over the floor of the nave and transepts.

The "*written record*" alluded to, is in the muniment room at Studley Royal; and it discloses the fact that a man was prosecuted for stealing "*pigs*" of lead from the Abbey at Fountains, in the time of Sir Richard Gresham, who had the site granted to him shortly after the dissolution.

I think these pots have been placed for some *local use*, which it is now impossible to guess. Their position proves that they could not be of much use for holding oil, or any liquid. They must have been intended to receive some *dry* substance, that could easily be taken out by the hand. One visitor, the other day, asserted that there was a similar instance in Durham Cathredral. But I cannot hear that such is actually the case. Mr. Walbran has written to the Rev. Jas. Raine (the Librarian of the Cathredal) on the subject, but a reply has not yet come to hand. Mr. Raine's able and learned little book on Durham Cathedral says nothing on the subject.*

Your Lordship remarks that this screen across the nave would have thrown the whole of the transept, north and south, into the choir. This arrangement was not uncommon, particularly in the Norman period; but the choir would only *cross* the transept, and the north and south ends would be screened from the middle space, the breadth of the nave, or perhaps the breadth of the nave and aisles: the choir of Westminster Abbey is continued into the nave, *as far as the fifth pillar from the east.*

Before the erection of the beautiful choir and Lady Chapel at Fountains, we know from the Abbey Chronicle (written by Hugh, a monk of Kirkstall, between 1225 and 1247) that the Norman choir was a contracted space, and too small for the "*unusual*" number of monks officiating at that period. This caused John de Ebor, the Eighth Abbot, in 1203, to project the erection of the new choir. The plan† of Kirkstall Abbey Church—a daughter of Fountains, and built under the superintendence of the brethren of the latter house, gives the best idea of what the plan of Fountains was, previous to the days of John de Ebor. The Church at Kirkstall has never been altered in *plan* from its Norman form. Insertions of perpendicular windows, and the addition of a story in the same period (temp. Henry VII), to the centre tower, have taken place; but in plan the Church is just as it was first built, and I have no hesitation in saying that it was copied from Fountains.

If we dig a slight trench down the *centre* of either the north or south aisles of the choir at Fountains, from east to west (where the pavement is all gone, and where we can do no harm), we shall very probably discover the site of the eastern wall of the old choir, for I know that in several instances, where similar elongations have occurred, the old walls were only pulled down to the exact level of the floor.‡

* Mr. Raine has communicated with Mr. Walbran on the subject. He says there is nothing of the kind in Durham Cathedral. All traces of ancient arrangement *on the floor* have been obliterated.

† See Sharpe's Architectural Parallels; Ground Plans, Vol. 1.

‡ His Lordship having expressed a wish that the termination of the Norman choir should be sought for, on Monday last (5th June, 1854), after half an hour's excavation, it was found together with the eastern walls of the first north and south chapels. It differs slightly from that at Kirkstall, inasmuch as these *first* chapels, on either side, are longer than the others. Its extent and position is indicated on the plan. Mr. Walbran discovered the Norman choir at Sawley shortly after the completion of the excavations there.

I think, too, that the choir at Fountains may once have been continued further down the nave than the screen on the east side of which the pots have been found. There are clear indications of another screen—a wooden one; on the 6th or 7th pillars of the nave, from the west. But the whole of the church has been screened and divided into chapels with altars, in every direction. The space for 94 feet from the west door down the nave has been clear, because the "processional stones," fifty-two in number, extend so far. The choir would also be clear, but, except these two spaces, it has quite surprised me to find how the whole Church has been crossed and recrossed by screens both of wood and stone.

I hope soon to forward a new, large, and detailed plan of the Abbey Church. Since I have commenced taking measurements and drawings, and looking after the man making the moulds, I have accumulated a quantity of interesting matter and details, which I hope shortly, through the kindness of Captain Smith, to lay before your Lordship.

Ripon, 22nd April, 1854.

My Lord,

The large traced facsimile of Abbot Huby's Initials (A.D. 1494—1526) which I had the honor to forward the other day was, very recently, taken from the house of Tinsley the Blacksmith, in the Village of Fountains. At some period it had been purloined from the Abbey; and, I believe, has formed some portion of one of the stone screens built in the time of Abbot Huby, in the Abbey Church. This stone is interesting and curious on two or three accounts. The letter M is formed of two serpent-like winged wyverns entwined in close combat. Unfortunately the head of one, and the claw or leg of the other, has been broken off. The H is composed of a stately looking raven, apparently treating with indifference the bite of a winged asp. These letters are decidedly Saxon, or early Norman or English in their character, and it is not unreasonable to suppose that "My Lord Abbot" has selected them from some of the many old illuminated MSS. the Library at Fountains possessed. The crozier, as in other examples of Marmaduke Huby's Initials, passes through the mitre, and the scarf or vexillum that was frequently wrapped round the *staff*, is well expressed. The label, above all, has no doubt borne a *painted* black-letter inscription, but long exposure to the weather has worn away all trace of it. The stone is a piece of tolerably hard flagstone grit.

The drawing of "Brother" Rypon's tombstone, I have taken pains to have delineated with every fracture that occurs on the original, to show how the sepulchral memorials have been shattered by the reckless destruction of the roofs, and by the large stones thrown down from the summit of the walls. This will account for the *non-discovery* of the many gravestones we expected to find on the floor where the centre tower stood. From that valuable record, "the President Book," we learn that, after the chapter-house was about full, the place of interment of most of the Abbots was the space in the middle transept, immediately in front of the choir screen. The solitary 4 at the conclusion of the inscription on Rypon's tomb, and the character of the black letter, may warrant a practised eye in referring its date to 1504, 1514, or 1524.

Just outside the newly discovered west-porch three beautiful perforated plates of lead have been found; two are exactly alike, and I have taken a gutta-percha impression of one, which I forward by this post. We found a similar fragment of lead in excavating the Abbot's house, but its style of design was a century later than these now discovered, which may be referred to the Decorated Period (A.D. 1290—1390). A like relic was found in clearing out the Abbey at Sawley. The one I have drawn weighs 2¼ oz. The other two weigh slightly over 3 oz. each. They are perforated, and

both sides bear the same design. We at first imagined that these curious relics had been used for the purpose of more readily covering the panels of Aumbrye Doors, or fine and small screen work, with elaborate tracery. Supposing the wooden surface to be first coloured with bright vermillion or ultra-marine, this leaden tracery work, well silvered or gilt, would produce a rich effect. But the fact of the plates being *alike on* BOTH *surfaces*, destroys this theory. They may have been *patterns* moulded, and cast in lead, by the designers in the middle ages, and sold to the Ecclesiastics or their architects, as new styles arose during the progress of Gothic architecture.* At all events, they are very curious and valuable relics, and, if not taken into your Lordship's private collection, will be interesting objects in the Abbey museum.

The workman I have employed to take different casts about the Abbey, has completed moulds for—

Three early English brackets:

The broken figure of the Virgin:

Two bas-relief sculptures of the Evangelists:

The Lombardic Inscription on Abbot John de Cancia's tomb:

The Initials of Abbot Huby:

A niche and canopy, containing the figure of an Angel holding the arms of the Abbey;

this is above the lowest east window of the tower. Some lesser objects I cannot now clearly remember, as I have not all the moulds in my possession.

The workman is now employed on a small figure above the lowest large north window in the tower. It proves to be a crowned female martyr saint, holding a palm branch in the right, and a book in the left hand, (perhaps St. Margaret).

I would draw attention to the fact that the *highest inscription* on the tower *has never yet been decyphered*, partly on account of its position, but more particularly of its decayed condition. I have read portions of it through a good telescope; but it is impossible to make it out clearly, unless an experienced person were face to face with it. It may only be a religious inscription —perhaps a repetition of those below—but, to judge from other examples I have read of, and seen, it is not improbable that it may contain some information of importance, historically, as regards the Abbey. A similar black letter inscription on the south west tower of York Cathedral bears the name of the "*Treasurer*," John Birmingham. With a little scaffolding, from the top, this inscription at Fountains might easily be reached, and read.

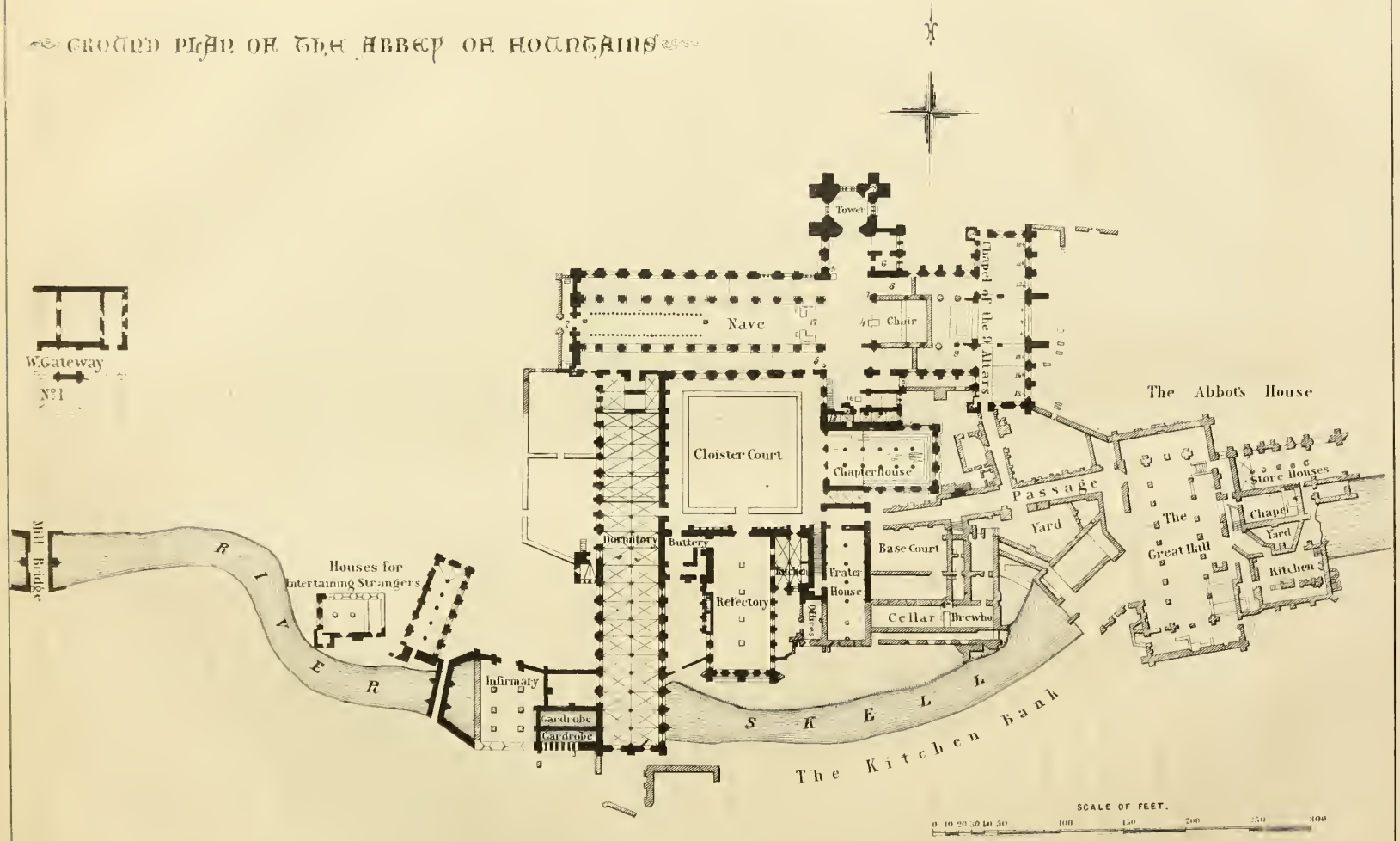
In conclusion, I would add, that I sincerely hope and trust that the noble and spirited example set by your Lordship, not only in this *great* work, but also in the lesser one on the banks of the Ribble, will be speedily followed by other proprietors of our monastic remains. The time has arrived when this should be accomplished. Very few Abbeys now present the same appearance as those of Fountains, Sawley, and Jervaulx. It is sad to call to mind the present state of Byland, Rivaulx, Kirkstall, Mount Grace, Guisborough, Easby, Coverham, and a score of others I could mention. Their storied pavements, the tombs and graves of our old patriots and dignified ecclesiastics; and the architectural fragments of their superb but "bare and ruined choirs," yet lie shrouded in the rubbish which "an undistinguishing reformation has heaped on their heads."

Your Lordship's obliged and obedient Servant,

WILLIAM HARRISON.

* Professor Willis has clearly proved to me that these perforated lead plates are nothing more nor less than ventilators; and he has seen similar specimens yet occupying their original position in old windows.

GROUND PLAN OF THE ABBEY OF FOUNTAINS



Vincent Brooks Imp. King St. Covent Garden

ON THE INFLUENCE OF SOME EXTERNAL AGENTS ON THE DURABILITY OF BUILDING MATERIALS.

By Geo. R. Burnell, C. E.

Read at the Ordinary General Meeting of the Royal Institute of British Architects, June 5th, 1854.

When the very imperfect state of that part of meteorology which treats of the constituent parts of the atmosphere is considered, it cannot be a matter of surprise that little is known to guide us to any definite conclusions as to the causes which affect the durability of building materials, and to their modes of action even under ordinary circumstances. Experience and tradition are the only authorities upon a subject of such importance; and the rules at present adopted in the selection and employment of the various classes of building materials can hardly be considered other than empirical. In the following article it will, therefore, be my object merely to state what is known and acted upon; and at the same time to call attention to some phenomena which require explanation.

The influence of the atmosphere upon building materials is of a complicated nature; it is chemical, mechanical, and *medial*, under which term are included all the various modifications produced by moisture, heat, and electricity.

The chemical influence, or, in other words, the decomposition determined by chemical affinity, depends, of course, upon the composition of the atmosphere itself, and this is known to vary in an extraordinary manner in different localities. The normal composition of atmospheric air is considered to consist principally of oxygen and nitrogen, in the proportions of 208 of the former to 792 of the latter; but there are also numerous other gases present, such as the carbonic acid, ammoniacal, hydrochloric, nitrous, and sulphuric, with sulphuretted hydrogen; the proportions of all which are affected by local causes. Even in the same locality the composition varies with the elevation above the ground, and the application of some theoretical deductions have led to such signal failures, as to justify us in dwelling on the necessity for examining carefully the actual conditions of each position.

It is to Messrs. Dumas and Boussingault that we are indebted for the analysis of the atmosphere quoted above, and from the researches of numerous other philosophers it appears that the proportions of oxygen and azote are constant. Messrs. Boussingault and Levy ascertained that the quantity of carbonic acid gas varied from 3.253 to 2.989 parts of gas (in volume) in 10,000 parts of air, the former result having been obtained at Paris, the latter at Andilly, near Montmorency; but Michel Levy states that the quantity of this gas in suspension varies between 4 and 6 in 10,000, the smaller quantity being that most frequently found in the open country. Carburetted hydrogen is found most abundantly in the neighbourhood of marshes; nitrous acid gas in districts which are subject to violent storms, and it is supposed to be generated by the decomposition of azote by electrical action. M. Fresenius (Ann. de Chim. 1849, p. 208) states that he found the proportion of ammonia in the air to be in 100,000 parts in volume, 0.133 ammonia, 0.205 oxide of ammonium, and 0.379 carbonate of ammonia. But M. Boussingault's observations upon the quantities of ammonia in rain water show that it varies notably according to the position, from 1 to 5.45. Under all circumstances the air of the night is richer in ammonia than that of the day, a fact which may be accounted for by the theory of the nutrition of plants, and the precipitation of ammonia by the early morning dews.

M. Chevalier (Journal de Pharmacie, 1835) found that the atmosphere of London contained sulphuric acid, generated no doubt by the combustion of coal. The same author also observed that the atmosphere of Paris contained the acetate and the hydro-sulphate of ammonia, which are to be attributed to the exhalations from the numerous cesspools of that town. M. Vogel, of Munich, has the merit of having ascertained the presence of hydrochloric acid in the atmosphere surrounding the waters of the Baltic and the Mediterranean. The action of the sea breezes upon some building materials, to which I shall have occasion hereafter to refer, appears to prove that this gas is not confined to those seas. As it is furnished by the evaporation of the ocean, it necessarily varies in quantity according to the season; and we may also suspect that other deleterious gases are from time to time suspended in the atmosphere, though their existence can hardly be demonstrated on account of their minute proportions.

The meteorological conditions of the atmosphere are subject to periodical variations, and they have distinctly marked phases of day and night, unless extraordinary phenomena occur. Thus, in clear weather the atmosphere attains two maxima and two minima in its electrical state; the first maximum being between seven and nine in the morning, and the second between seven and nine in the evening; the first minimum about four in the morning, and the second between five and ten in the evening; but it must be observed that its hygrometric state frequently modifies these periods. The intensity of the sun's light, and necessarily of its actinic influence, has its maximum rather before mid-day, and two minima corresponding nearly with the periods of twilight. A maximum occurs in the temperature about two o'clock in the afternoon upon the average of the year, but there is a slight irregularity according to the seasons; a minimum occurs, generally speaking, when the sun occupies a position about 14° 47′ below the horizon, according to M. Bouvard's observations in Paris; the period of mean temperature varies in the different months. The atmosphere is driest about mid-day, and contains the greatest amount of moisture at night; the deposition of dew takes place to the greatest extent between midnight and sunrise, on account of the greater cold which then prevails. In our latitudes the disturbances of the barometric action are not marked by any regularity; but there is a tendency to increase in the morning, when the barometer generally rises; it falls about mid-day, rises again about sunset, and falls once more about midnight. It may, in fact, be considered that the meteorological fluctuations of every day are affected by the relative positions of the sun and the earth, and that they correspond more or less closely with the cardinal positions of the former at rising and setting, at mid-day and midnight.

The mean temperature of London throughout the year is 50°.50′., whilst that of the surrounding country is 48°. 50′. The thermometer very rarely rises above 96°., and the greatest cold hitherto recorded in our metropolis is 5°. below Zero. The mean barometric range amounts only to 2.07in.

One of the most important conditions of the atmosphere depends upon the rate of evaporation, and the amount of humidity in suspension; and the intensity of these agents is greatest at directly opposite seasons of the year. Evaporation is greatest in summer, and least in winter; the reverse takes place with respect to humidity. Mr. Daniell estimated the mean evaporation in the neighbourhood of London at 23.974 inches per annum, ranging in the various months from about half an inch in January and December to $3\frac{3}{4}$ inches in June, and $3\frac{1}{4}$ inches in July. Supposing the complete saturation of the atmosphere to be represented by 100; the humidity of the months of December, January and February will then be expressed by 92. In the intervening months the humidity diminishes with tolerable regularity to the minimum of 78 at the end of June, except in the month of May, when a trifling irregularity occurs. It thus happens that the greatest amount

of moisture is suspended in the air, to be absorbed by porous materials, precisely at the season of diminished temperature and exposure to the attacks of frost; while evaporation takes place at the period when the conditions of temperature are most favourable to the production and development of the salts by the previously absorbed moisture acting on the earthy bases.

Such we may consider the general properties of the atmosphere likely to affect the conditions of building materials, and we may trace their influence under circumstances apparently very dissimilar.

The various external agents produce effects, either by the new combinations they superinduce between the earthy bases, the metals, and the metalloids of the different classes of building materials and the gases they contain; or by the solution and removal of the combinations previously existing. There are few, indeed we may almost say that there are no conditions either of organic or inorganic chemistry which can be considered permanent; and as the gradual decay of rocks is a law of nature everywhere, and inevitably, at work to renew the face of the world by apparent destruction, it is not to be expected that the insignificant quantities we deal with can be exempt from similar laws. The consideration of the circumstances attending the formation of the new compounds of oxygen, hydrogen, carbonic, ammoniacal, and hydrochloric gases with the bases above mentioned; with the action of the fermentation of woody sap, would lead to a lengthened investigation of the most abstruse branches of chemistry. The importance, however, of these compounds cannot be too strongly insisted upon, nor can the attention of scientific men be too decidedly called to them. Sometimes they act to destroy, at others to consolidate; but in all their influence is very marked, and calls for serious consideration from the architect. Limes, cements, and some descriptions of building stones, when properly employed, gain in strength and durability by the slow, but sure, action of the air. When injudiciously employed they rapidly decay, through the decomposition to which that element gives rise, or the mechanical agents to which it serves as a medium; while the destruction of the metallic or the organized matters employed, is equally occasioned by the same cause. I shall now proceed to point out the various phenomena exhibited by the respective classes of building materials usually employed in London, not attempting, however, more than a very general description of a subject so vast, and at the same time so complicated.

Granites present many varieties, differing greatly in their composition and the mechanical arrangement of their elements. Those from Devonshire and Cornwall contain a large proportion of schorl, and are frequently pervaded by masses of felspar, of such dimensions, and so distinctly crystallized, as to cause them to assume a porphyritic character. According to Sir H. De la Beche. the granites of Ireland are of the same character, but the schorl occurs in smaller proportions, The granites of Aberdeenshire are more decidedly micaceous, and schorl is rarely found in them; they also differ from those of England and Ireland, in having their component parts more equal in volume, and more evenly distributed. In some cases hornblende takes the place of mica, and in others the quartz and the felspar are both so much affected in colour by the presence, doubtless, of hydrous oxide of iron, as to give a general rosy hue to the whole mass. An instance of this is the well known granite of Peterhead. The granites of Guernsey, Jersey, and the Isles Chausey, which are occasionally brought into the London market, resemble those of Cornwall; and, indeed, M'Culloch, in his "Classification of Rocks," states that they pass into the same variety. Their appearance is, however, sometimes diversified by the occurrence of large imperfectly shaped crystals of compact felspar, which give the whole mass either a greenish tinge, as in the case of the Guernsey, or a rosy one as in that of the Jersey granite.

The decomposition of granites takes place from the action of the atmosphere upon their con-

stituent particles. "The quartz is almost pure silicious earth, in a crystalline form. The felspar and mica are very compounded substances; both contain silica, alumina, and oxide of iron. In the felspar there is usually lime and potassa; in the mica, lime and magnesia. When a granitic rock of this kind has been long exposed to the influence of air and water, the lime and the potassa contained in its constituent parts are acted upon by water and carbonic acid; and the oxide of iron, which is almost always in its least oxidized state, or in that of the protoxide, tends to combine with more oxygen; the consequence is that the felspar decomposes, and likewise the mica, but the first the more rapidly." Such are the words in which Sir H. Davy (Agricultural Chemistry, p. 189) describes the mode of decomposition of granites; and they may be taken to express the present state of science so far as the granites usually employed in England are concerned. But there appear to be different conditions in the combinations of the bases of felspar which give rise to some apparent anomalies. Thus, the Egyptian porphyries, which contain a notable excess of rose-coloured felspar, resist the influence of the atmosphere in an extraordinary manner. Possibly this may be accounted for by the closeness of the grain (so to speak), which would to a certain extent prevent atmospheric moisture from communicating with anything beyond the immediate surface; or the more simple character of some of these porphyritic rocks may be favourable to their preservation; whereas the different rates of expansion of the ingredients must have a material mechanical influence in disintegrating rocks when they exist in considerable numbers. The difference between the rapid rate of decomposition of the porphyritic granites of Spain, Britany, and Cornwall, and that of the Egyptian specimens appears to justify the inference that the cause last suggested has great influence upon their durability. The former are, in fact, composed of a greater number of ingredients than the latter, in which both mica and hornblende are wanting.

Practically it is found that the uniform character of the Aberdeen granites resists atmospheric influences in our latitude better than the more easily worked stones of Devonshire and Cornwall.

It may, perhaps, be as well to call attention to the fact that the modern application of the term "porphyry" is in some cases inconsistent with its derivation; the *grey* granites of Devonshire, Cornwall, and the N. W. of Spain, being occasionally called porphyritic, as well as the *purple*, felspathic rock of Egypt. The latter is almost entirely composed of felspar, with occasional crystals of amphibole and quartz; but the colour is entirely owing to the felspar, which is of a beautiful purple occasioned by the presence of a large proportion of the hydrous oxide of iron. Ophite (green antique porphyry), and melaphyre (black porphyry) are instances of a similar disregard for the derivation of a generic name. A description of granite, known to mineralogists by the name Syenite, was also much used by the ancient Egyptians; it is remarkable for having the mica replaced by hornblendish amphibole, and is of a rose colour. The atmosphere does not appear to have much action upon this variety, at least in Egypt, if we may judge by the state of Pompey's Pillar, and Cleopatra's Needle.

Whinstones, or basalts, become disintegrated unequally under the effects of exposure to the atmosphere, in consequence of the variable proportions of felspar they contain, and perhaps also of the particular combinations of alumina, lime and magnesia, which, in connection with silica, constitute their base. If any potassa be present in combination with the silica in the shape of felspar, the action is more rapid than under ordinary circumstances, the humidity of the atmosphere decomposing the felspar into two substances, one of which is soluble, and easily removed by succeeding rains. Serpentines, and the diallage rocks, which are silicates of magnesia combined with hydrates of that base, yield easily to the attacks of acids when the silicates are in certain proportions, and alumina is present. The most beautiful varieties of these materials employed in the arts are obtained

from the environs of Genoa, and from Zœblitz in Saxony; but it is much to be feared that the atmosphere of large towns, especially when containing sulphuric acid gas from the combustion of coal, renders the employment of even the best of these decorative materials very hazardous. It appears also that in parting with their water of crystallization upon exposure to the air, an unequal contraction takes place in the constituent parts of the serpentine obtained in certain localities, which in consequence breaks in an irregular manner.

The next description of building materials to be considered, in following the ascensional order of the geological series, are the slate rocks. Those worked for the supply of the London market are principally situated in North Wales, Cumberland and Westmoreland, the former being a tolerably homogeneous clay slate, the latter being much more chloritic. Exposed freely to the action of the atmosphere both varieties appear to be tolerably durable, but Westmoreland slates decay very rapidly in damp positions, when the air around them is not frequently renewed. They decay, in fact, in the covered parts, probably from the decomposition of the silicate of iron to which they owe their peculiar colour. The combination of silica and alumina in the Welsh slates appears to be more stable than that which prevails in any other material of the same nature; for their powers of resistance to atmospheric influence are greater than those of any slates employed in Western Europe, or North America. As a general rule, the denser the slate the more durable it will be; and the most important condition to be observed in its use is that water should not be allowed to percolate between the edges of the strata. Practically it is found that the smoother the surfaces of the slates, and the closer they lie, the greater is the pitch requisite to be given to the roof; because, under such circumstances, capillary action takes effect to a greater extent than when the slates present irregular and perceptibly large intervals.

The various sandstones, millstone grits, and conglomerates, are affected by the atmosphere, either through the decomposition of the material cementing their particles together, or by the mechanical effects of moisture. These last may consist, either in the removal of the cementing material, or in the destruction of the cohesion of the particles by the expansion of the water in freezing. Many of the sandstones occur in regular layers, separated by thin films of a species of clay, as in the common Yorkshire flagstones, and when these films are sufficiently thick to offer an efficient resistance to the passage of water, to retain it in fact under the upper shale, the expansion during frost will almost inevitably destroy the stone. If the water should change its form from other causes, such as heat, the same effect will be produced; and it is therefore found that the Yorkshire stones of a very porous, and at the same time of a very fissile character, are unable to resist the extremes either of cold or heat. The best materials of this description are those of an homogeneous nature—such as the Park Spring, the Idle, and the Darley Dale stones, in all of which the minute subdivisions disappear, and the mass may be described as consisting of an assemblage of distinct molecules of similar nature, united by mechanical juxta-position.

The sandstones, in which the silicious molecules are united by a calcareous cement, are far more susceptible of decomposition than those united by a silicious cement, for it appears that in the former cases the chemical combination is rarely effected between the lime and the silica; as the latter is not in the state known as free silica, nor such as can easily form combinations with other materials. In the case of some of the millstone grits, however, the cementing substance, which is silicious, forms so energetic a combination with the molecules it envelopes, that both resist the action of external causes in an equal manner, and the durability of the Bramley Fall stone may fairly be compared even to that of granite itself. These remarks may be extended to the conglomerates, in all essential respects at least, because in fact, generally speaking, they differ from the millstone grits only in the size of their elements.

The crystalline marbles vary in such a very marked manner, both in the nature and the proportions of some of their constituents, and they have been so modified by the accidental circumstances of their geological position, that it is more than usually difficult to trace the laws of their decomposition under the action of atmospheric causes. In many instances they are traversed by veins filled in with more perfectly defined crystals of the base of the rock, or the fissures caused by these veins are filled in with extraneous matters, such as clay, and sometimes even with minerals. Again, however regular the structure of the mass may seem, there is always a tendency in the more crystalline rocks to assume a distinct cleavage, which is often different from the direction of the planes of stratification. Under such circumstances, the moisture furnished by the atmosphere either furnishes the elements necessary for the decomposition of the materials introduced into the veins, or by the mechanical effects it produces in consequence of the changes of temperature, disintegrates the mass. The former class of phenomena may be most distinctly observed in the Breccias, or such marbles as the Brocatello and the Oriental Jasper; the white marbles very frequently exhibit the cleavage above alluded to, and are the most exposed to the injuries produced by the infiltration of water between the planes of division. It is to be observed that the species of false stratification indicated by the cleavage is most apparent in the rocks which, like the slate rocks, have been affected by proximity to igneous formations, and that the more crystalline the marble the more exposed it is to this inconvenience. At the same time it must be observed that the more perfectly crystallized carbonates of lime, under which denomination in fact nearly all the finer marbles may be included, resist the chemical influences of the atmosphere more successfully than similar substances where the forms are not so distinctly marked. It would appear as though the process of crystallization were accompanied by the development of some chemical affinity between the ultimate particles, similar to that which is noticed with respect to the various forms of silica, and which enables them afterwards to resist more energetically external causes of decay. In some marbles the joints assume different directions from either the lines of stratigraphical deposition, or from the planes of cleavage; but in the practical operations of building the consideration of this peculiarity may be neglected, because they are usually so distinctly marked as to place in reality the natural limits to the sizes of the blocks raised.

M. Durocher communicated to the Académie des Sciences a memoir "sur l'absorption de l'eau atmospherique par les substances minérales," which throws some light on the subject of the decomposition of silicated materials, or those containing metallic oxides. From his experiments it appears that all substances of this description actually absorb water from the atmosphere, and undergo a commencement of hydration, which must necessarily facilitate the decomposition of mixed minerals, such as the silicates, and is apparently the commencement of that action. Messrs. Jamin and Bertrand have also shown that in porous bodies gasses are condensed with remarkable facility, so that it is possible that the conditions of molecular aggregation influence the durability of mineral substances in the direct proportion of the facilities which are offered to the passage of air to the interior. From this we may infer that the existence of a crystalline structure is in itself a protection to the materials in which it may occur, because under such circumstances the porosity is usually less; or at any rate the intervals between the ultimate molecules are proportionally smaller than in the case of materials held together simply by aggregation without crystallization. Sir H. De la Beche notices the universality of this law (Geol. Observer, ed. 1851, p. 8), but he does not attempt to account for it.

The magnesian, the oolitic, and the ordinary secondary and tertiary limestones, are liable to decay under the influence of the atmosphere with very various degrees of rapidity; and it is,

moreover, to be noted, that the same formations yield materials varying singularly in their powers of resistance according to the position they occupied in the quarries, and the exposure of the building in which they are employed. The results obtained by the use of the Anston magnesian limestone, and the marked differences to be observed in the Bath, Caen and Portland Oolites, as well as in the several members of the tertiary series of the Paris basin, appear to show that no *a priori* laws can be laid down with respect to their durability when exposed to the air. All these classes of materials are supposed to have been deposited by waters containing their elements in solution, and if they were once in that state (*i. e.* of solution) it must be evident that they are always susceptible of passing into it again, if the necessary conditions are presented, unless the deposition should have been effected by the introduction of some additional element, or such element should have been supplied at a later period. There is another chemical agent at work in many cases to hasten the decomposition of the sedimentary rocks unaffected by Plutonic action, namely—the animal matter which they so often contain; and as the distribution of this matter is not subject to any definite law it necessarily produces irregular effects. Occasionally, also, the body of the stones is traversed by numerous fissures which have been subsequently filled in by more crystalline materials of greater powers of resistance; and again, the chemical nature of these stones often varies, owing to the presence of more or less silica in combination with the ordinary bases. Every possible variety in the mode of disintegration may therefore be observed in these stones.

Experience has shown that the magnesian limestones are not more capable of resisting the effects of our London atmosphere than the carbonates of lime formerly used, when proper care has been exercised in the selection of the latter. Mr. Rogers indeed remarks (Brit. Assoc. 1849) that rain-water slightly carbonated takes up the carbonate of magnesia more rapidly than it does the carbonate of lime, and that the magnesian silicates are easily soluble even in pure water. Forchhammer also observes, that water which contains carbonate of soda acts easily upon magnesian rocks. Now it is very probable that the rain-water falling through the atmosphere of London should be charged at any rate with carbonic acid gas, and thus become extremely prejudicial to this class of materials; and it is possible that the rain may give rise to a catalytic action between the lime and magnesia contained in this class of stones, which would facilitate their decomposition. Every stone, as may be gathered from what has been said above, is exposed to decay in the precise ratio of its porosity, but in addition to this cause of disintegration, which acts principally by allowing water to exercise its natural mechanical powers, all the ordinary building stones are exposed to the peculiar process known by the name of nitrification, which, in consequence of the formation of the crystals of nitre, combined with a base, tends to disintegration of the surface. The magnesian limestones allow the development of this process as freely as the carbonates of lime, even if they do not offer extraordinary facilities for its action. The generally received opinion is, that the azote, furnished by the decomposition of the animal matters diffused through the rocks, combines with the oxygen of the atmosphere to form nitrogen, which latter gas in its turn combines with the soda, existing in small quantities in all sedimentary deposits, to form the nitrate of soda, or the saltpetre of commerce. Dumas says that azote and oxygen combine most readily under the influence of electricity, but that the energetic bases, lime and magnesia, may suffice, especially when moisture is present, to replace that intermediate agent. At any rate this chemical operation takes place in nearly all building stones of a porous nature, and it may confirm the common opinion that of stones, of the same description geologically, the densest are the most likely to resist the action of the atmosphere.

The phenomena of the saltpetring of building materials are very little understood; but there are certain practical rules which may serve to guide the architect in his endeavours to avoid the incon-

venience arising from it. They are, first: To employ, if possible, in damp positions, either granite, the mill stone grits, the conglomerates of a purely silicious character, or sandstones free from animal matter, and the sulphate of iron.

Secondly. If the cost of either of these classes of materials should render their employment impracticable, the use of any of the ordinary limestones should be avoided in positions where they are exposed to warm dampness, should it be desired to execute any coloured decorations upon the immediate surface of the walls When from local considerations it may be advisable to employ these materials in basements, or other damp positions, they must be separated from the upper structure by the interposition of a layer of some impermeable material, to intercept the passage of the water, which would otherwise be absorbed by the capillarity of the upper stonework.

Thirdly. Every precaution must be taken to prevent the saturation of the ordinary limestones by sea water, and the use of sea sand in the mortar to be employed with them must be carefully avoided, because sea water furnishes the salts of soda most likely to assist in the formation of the nitrates, and sea sand is also highly impregnated with the same salts. It is equally known that the atmosphere of the sea shore holds in suspension a notable quantity of the various salts which pass off by evaporation from the surface of the sea, and it is for this reason that stones which are exposed to nitrification suffer more rapidly in such positions than in the interior of the country.

Fourthly. To isolate decorative works effectually from the walls formed of materials in any way susceptible of saltpetring. Of late years attempts have been made in Paris, and some other continental towns, to revive the practice of mural decorations, but the results have generally been unfavourable, in consequence of the chemical action of the atmospheric moisture transmitted through the pores of the stones. So seriously has this cause been observed to affect internal decorations, that the architect of the new Hôtel du Ministère des Affaires Etrangères, M. Lacornée, has lined the inner surfaces of the walls destined to receive either silk panels or paintings with sheet lead, and has then battened out independently of them. In the new church of St. Vincent de Paul the painting on the dome behind the high altar has begun to fade from the effects of the transmission of the moisture of the atmosphere through the stone vaulting. This work has not been executed more than about twelve months.

It must be observed with respect both to the carbonates of lime and the magnesian limestones, that their principal elements exist only in the state of subcarbonates while the stones remain in the rock They absorb carbonic acid from the atmosphere, and harden by exposure to the air; but as the hardening process would augment the cost of labour, and is moreover very slow in its action, it is rarely resorted to in practice. For many reasons, however, it would be desirable to quarry the stone required for an important building twelve months before it is to be employed, because the danger to be apprehended from frost would be avoided, and the carbonization would be more perfect. Another very useful precaution is to cover the exposed surfaces with a wash of some description, able either to close their pores or to produce a chemical action on the stones themselves. The practice of some London masons of painting the stone work as it is carried up, with a thick slime of stone dust and water, acts in the former manner; the washing all exposed surfaces with an alkaline silicate acts in the latter, and it would be unquestionably preferable were it not that in some positions the addition of even the small quantity of soda, requisite to hold the silica in solution, might furnish the element of the saltpetre.

Of late years attempts have been made to cast doubts upon the correctness of the generally received opinion, that it is essential to place stones on the same bed as they occupied in the quarry. With some few stones when in place, it may be true that the position of the layers is a

matter of indifference; for the roche do St. Cloud, and the Villebois stone of the neighbourhood of Lyons, amongst the secondary and tertiary limestones, have been employed without reference to the planes of bed for many centuries without inconvenience. But these cases are decidedly exceptional, and even in them the powers of the stone to resist a crushing weight are less when it is applied in a direction parallel to the beds, than when it is applied transversely. In almost every other case it will be found that when stones are used the wrong way of the bed, to employ a workman's phrase, they disintegrate in parallel plates. Great care requires to be exercised to ascertain the precise direction of the natural beds, because many stones present the appearance of inclined planes of deposition, which cut the beds and joints under every modification of angle. When from the stones having been worked in the quarry it is difficult to ascertain the precise bed, it is possible that the mason may be misled by the greater facility with which they work in one direction, and may mistake this cleavage for the real bed. The only remedy appears to be to cause the stones exposed to this danger to be marked in the quarry, but fortunately the examples of its occurrence are rare.

The principal danger of exfoliation arises from the expansion of the moisture contained in the stone under the influence of frost, and a very elegant process was invented by M. Brard, for the purpose of ascertaining the probable extent due to this cause. M. Brard in his experiments upon the resistance of stones, caused them to be boiled for half an hour in a saturated solution of the sulphate of soda. They were then withdrawn and allowed to stand in a flat vessel, at the bottom of which was a small quantity of the same solution, the first efflorescences were washed off, and the degradation of the stones during the next five or six days, under the effects of the continued efflorescence, were taken as an indication of the probable extent to which they would be affected by frost. In the first volume of Rondelet's Art de Bâtir, page 307, (ed. 1842, Paris), M. Brard's process is described in detail; but some very curious experiments recorded in vol. 7, 1re. serie des Annales des Ponts et Chaussées by M. Minard, together with an article by M. Vicat, inserted in the same volume, throw very considerable doubts upon the exact amount of dependance to be placed on its indications. M. Vicat, indeed, very properly observes, that it still remains to be proved that the expansive action of water in freezing is identical with that of crystallization, which can only produce energetic effect at temperatures between 68° and 86° Fahr. According to this very accurate observer, stones which are exposed to a southerly aspect, on the north of the equator, are more affected by frost than those exposed to the north; and the most efficient protection to materials of this description of a porous nature is a coating of oil paint, or any other fatty pigment which prevents moisture from being driven or absorbed into the stone. M. Minard recommends that stone should be quarried in the spring, and not employed in a building until it has been exposed to the effects of one winter at least.

In many varieties of the oolites, the fossil shells are to be observed left in high relief upon the surface by the decomposition of the materials in which they were embedded, and in Bath stone the veins of calcareous spar frequently become detached. It appears that the cause is the same in both cases, and that the shells and the veins protrude in consequence of the resisting powers of the more perfectly crystallized carbonate of lime, of which they are composed, exceeding those of the amorphous mass in which they are embedded. When nodules of flint or chert occur in the numerous varieties of carbonate of lime, the stone around them is usually more durable than the general mass of the rock, doubtless because it contains a portion of the silica in combination with the lime. It is known, indeed, that the application of a soluble solution of silica will at all times add much to the durability of the purer carbonates of lime; but it is very desirable that the con-

ditions under which such a solution should be employed should be made the subject of close and careful experiments.

There are some varieties of arenaceous limestones and sandstones with calcareous cements, and a very remarkable silicious deposit, to be met with in the upper secondary and tertiary formations, which may eventually serve to throw light upon the chemical changes produced by the atmosphere in consequence of the very decided character they assume. For instance, the sandy beds of the Kentish rag perish in consequence of the mechanical removal of the sandy cement which binds together the particles of limestone. The grès or sand stones of Fontainebleau and Windsor forest as frequently decompose, in consequence of the removal of their calcareous cement by moisture, or by the action of the air; whilst the silicious beds of the lower chalk appear likely, from Mr. Way's experiments, to furnish materials of inestimable value to plastic art, and also affording a convenient and economical supply of the soluble silica required to compensate the deficiencies in other more generally employed materials.

With respect to the gypseous formations, it appears that where they occur in sufficient abundance to be used as ordinary building materials, they absorb moisture from the atmosphere with extraordinary facility; while they decompose with such rapidity that the municipal authorities of Paris have forbidden their being used for the walls of houses. Occasionally, however, rubble plaster stone is used for enclosure walls, but it rarely lasts more than from twenty to thirty years, when exposed to the weather near Paris. The cause of this rapid decay, according to Gmelin, is to be found in the fact that the sulphates with an earthy base (gypsum being a sulphate of lime) are soluble in water. It is also to be observed that many of the gypseous deposits, especially those found near Paris, are impregnated with an extraordinary proportion of organic matter; this decomposes on exposure to the air in warm and damp positions, and gives rise to the formation of nitrous salts to such an extent, that the saltpetre used by the French powder manufacturers, during the last war, was almost entirely obtained from cellars constructed of rubble masonry, set in plaster in the style usually adopted in France. It is possible that the gases which are present in rain water, or in the atmosphere, may give rise to a species of decomposition by relative affinity, in combination with the sulphuric acid of the gypsum.

Atmospheric influence upon bricks, tiles, and other building materials obtained by the burning of plastic clays, depends very much on the chemical composition of the clays, and on the degree of burning. Thus any distinct portions of limestone present in them would be converted into quick lime in the kiln, and when the bricks were thoroughly wetted would expand in such a manner as to disintegrate the mass. If the clay used is too poor, that is to say, if it contains an excess of sand, the bricks will not become sufficiently fused, and upon exposure to the weather their constituent parts will separate. It is to be observed that in bricks, as in stones, decomposition does not take place with the greatest rapidity where constant moisture exists, but rather where, from the influence of capillarity, variable according to the moisture furnished by the atmosphere either directly or indirectly, a series of alternations of dryness and humidity prevail. The foundation walls of buildings do not in fact suffer so much in the parts immediately upon the ground, as they do in those at a height of from one to three feet, according to the permeability of the materials employed. When bricks made of clay containing free silica are laid in mortar, and moisture can pass freely from either one or the other, it may be observed that the edges in contact become harder than the body of the bricks. No doubt this arises from the formation of a silicate of lime and alumina, the lime being furnished by the passage of the water through the bed of mortar.

Upon limes and cements the effects of the atmosphere are very marked, although at present

they are considered to be of far less importance than formerly. All the materials of this class, whether the hydraulic, or the rich limes, the cements, or the plasters properly so called, have a remarkable avidity for water, and abstracting it from the surrounding atmosphere assume the form of hydrates. If these occur in the conditions requisite to enable them to pass into the carbonates, or sulphates, a species of confused crystallization, or aggregation, takes place. But it must be evident, from what was said in the commencement of this notice, that the quantity of carbonic acid gas the atmosphere is capable of furnishing within a moderate period is exceedingly small, and the theory that limes or cements harden originally by the absorption of that gas, and the consequent conversion of the lime into carbonate of lime, must be abandoned. There can be no doubt but that the conversion of the lime into the carbonate must increase its cohesion, but the rapid setting, to use a workman's phrase, cannot be accounted for in this manner. It appears, so far as we are able to judge in the actual state of applied chemistry, that mortars harden in consequence of the formation of an insoluble silicate of lime and alumina, the silica being either furnished by the limestone itself, or by the sand, pozzolano, or other ingredient mixed with the slacked lime. When the setting has been once effected, the absorption of carbonic acid gas from the atmosphere may tend to harden a thin external film; but the very perceptible character of this film militates against the supposition that the cause producing it can act upon the interior of the mass.

Nevertheless the numerous classes of limes, cements, and plasters, exhibit very marked differences in their manner of resisting the action of the atmosphere. The purer carbonates of lime when used for the preparation of mortar, are excessively soluble in water; and if the mortar obtained from them be much exposed to the weather, or to the action of running water, it will be rapidly removed. The argillaceous limestones, on the contrary, furnish the elements necessary to form an insoluble double salt of lime with the silica and alumina; and if the mortars made from them be protected from running water during the period required for their setting, the action of either weather or running water subsequently will rather tend to increase their powers of resistance. The practical lesson to be drawn from these facts would appear to be, that none but the limes obtained from argillaceous limestones should be employed in damp situations. With respect to the use of plaster, the observations before made upon the gypseous stones will apply here perhaps with even greater force. Indeed the marked difference between the external aspects of the applied plaster and the natural stone, would show that in the process of calcination some element we are unable to ascertain must be driven off. It may be that the burnt plaster yields more readily on account of the absence of this very element; but certain it is that plaster of Paris very rapidly decays when exposed to the influence of the atmosphere.

Temperature appears to act in a distinct manner upon limes and cements, for if they are used in summer, without the adoption of any precautions to defend them from the sun, they invariably crack; and of course, if their water of crytallization becomes frozen in winter, the whole mass will disintegrate. The more rapidly limes or cements solidify, the more they appear to be exposed to the danger and inconvenience of cracking in warm weather, and it would appear that the most favourable condition for their resistance is when a certain degree of uniform moderate dampness prevails. It must also be observed, that sea air has a marked influence upon the durability of some limes, because the minute particles of sea-water it contains hold in solution many salts with which free lime has more affinity than with silica.

The decay of wood superinduced by atmospheric action, is affected by a different class of phenomena from those which tend to destroy stones and metals, namely, those connected with

organic chemistry; although at the same time the changes produced by inorganic elements are as powerful in the one case as the other. From the day when wood is felled to the day it is used, it requires care and attention, and when it is in place, precautions should still be taken to ensure its durability. Currents of air which are either renewed with too great rapidity, or are too dry, a temperature too elevated, constant moisture at high temperatures, alternations of dryness and humidity, absence of ventilation producing wet rot, the accidental transport by the atmosphere of the seeds of certain cryptogamous plants producing dry rot, and the attacks of insects, together with the fermentation of the sap of the trees, may be cited amongst the numerous sources of danger from which it is necessary to secure wood either when in store, or when employed.

When wood is exposed to frequent currents of air, especially at high temperatures, the moisture it contains evaporates too rapidly, and gives rise to cracks and fissures which either destroy the resistance of the material, or open a passage for the water contained at other times in the atmosphere to penetrate to the interior of the mass. If the temperature to which wood is exposed, whilst any sap remains in it, is too elevated, the vegetable fluids ferment; the tenacity is diminished, and when the action is carried to its full extent, the wood quickly becomes affected by the dry rot. Exposure to the atmosphere in positions where rain can lodge in quantity, contact with the ground, and application in damp situations deprived of air, will render wood liable to the wet rot; and however well seasoned it may have been previously to being brought within the influence of any of these causes, it will infallibly suffer. It is therefore of the highest importance, that whether in the merchants' stores, or subsequently when placed in a building, wood should be preserved from contact with the ground, and that air should have free access to it in every direction. The germs of destruction are often communicated whilst the wood is in store from neglect of these simple precautions; if they be once implanted, the progress of decay can never be subsequently arrested. It has been supposed that keeping wood in water tends to prevent the commencement of dry rot, because in that position the sap is washed out of the pores. If this theory is correct, it must be evident that the oftener the water is changed, the greater will be the probability of its producing the desired effect, because if it be allowed to stagnate it must become saturated with the sap in course of time, and unable to take up any additional quantity which may be present. Duhamel observed, that if wood were immersed immediately after it was felled, it would be less liable to decay than if put in water at a subsequent period; he also found that immersion tended to preserve the wood from the attacks of insects, and even to arrest the progress of some kinds of decay, but that a notable portion of the strength was lost. The drying and seasoning take place with greater rapidity after immersion, probably because the water displaces the sap, which does not evaporate so rapidly as the thinner fluid. Duhamel asserts that the process of charring the ends of posts, &c., built into the ground, is very inefficient, and that it is only of use to the extent of interposing an extraneous substance between the wood and the earth; in his opinion it would be better to enclose the lower ends in sand, stone, cinders, or other materials which would easily carry off the water supplied by the surrounding media.

When wood is converted and placed in a building, its durability may be greatly increased by covering it with a coating of paint, or other substance which will prevent the moisture of the atmosphere from obtaining access to it. But it is essential that the wood so covered should be free from sap, or internal moisture, or the very perfection of the coating will be found to accelerate its decay. Care must be taken to prevent water from finding its way into the joints, and if the

wood be exposed directly to the action of the sun, it should be painted of a colour able to reflect rather than to absorb heat. It is desirable that it should be planed before being painted, in order that the paint may be applied in an equal manner over the surface. It is important also to observe, that the moisture in the atmosphere not only affects the volume of the wood, but frequently alters the position of the fibres by producing a torsion analagous to that which may be observed in hygrometric cords.

Of late years the processes of Kyanizing, creosoting, and immersing timber in solutions of mineral salts, have been applied with various success for preserving it from rot, and the attacks of worms or ants. Of these, Kyanizing, which employs a solution of deutochloride of mercury, appears to be most satisfactory; and among some striking illustrations of its results may be cited the fence of the Regent's Park; the posts of which were inserted in the ground, without being painted, at least 18 years since, and remain at the present day in very tolerable condition. For railways, and harbour works, English engineers appear to prefer the system of creosoting, or immersing the timber in the rough oil of tar, until it has absorbed at least 7 or 8 lbs. per cubic foot. The difficulty of injecting so large a quantity of oil is overcome by exhausting the sap and moisture from the wood in vacuo, and then forcing in the oil under great pressure; a species of artificial drying is, however, frequently necessary, and indeed the success of this process appears to depend entirely upon the extent to which the original moisture is withdrawn. Both corrosive sublimate, and oil of tar, are capable of resisting the causes of decay communicated by the atmosphere, and the latter is said to be an effectual preservative against the attacks of boring animals; but it is to be feared that the ordinary manner of applying them does not ensure their penetration to a sufficient depth to attain the objects desired. The use of the sulphate of copper, and of the other metallic salts has hitherto been unsuccessful.

In the bent timber bridges which have been constructed on some of the recent lines of railway, although every ordinary precaution was taken in selecting the timber, immersing it in solutions of the metallic salts, and in painting it when in place, the wet rot has exhibited itself in so many instances as to render it almost necessary to abandon a system which appeared to have many recommendations. It is, however, to be observed that these bridges decayed solely because their elasticity caused them to yield upon the passage of every train. The play thus produced caused the joints to open; and moisture, furnished by rain, or the condensation of vapour, found its way into the interior of the beams. The failure of the bent timber ribs in such situations does not, therefore, in any manner affect the propriety of using that construction on more suitable occasions. A valuable lesson is, however, to be learnt from the above fact, viz., that it is difficult, if not impossible, to protect complicated systems of carpentry from the effects of the atmosphere, when exposed to the occasional action of heavy loads able to produce a disturbance of their main parts.

In the theatre at Munich a soluble glass was applied to the woodwork and scenery for the purpose of preserving, and, as far as possible, rendering them incombustible. This glass was in fact a solution of free silica in caustic alkali; and if the wood was properly seasoned, there can be no doubt of the value of the application, especially if it was injected under pressure. Professor Way's researches into the silica beds of the lower chalk prove that a solution of this nature could be obtained easily and economically; and the advantages it offers certainly render its application desirable.

The action of the atmosphere upon metals is even more complicated than that which takes place upon stones, because the electro-chemical changes are more efficient, and the metallic bases are susceptible of combining with a greater number of gases than the earthy bases or the metalloids. In

building operations the metals commonly used are iron, lead, copper, tin, zinc, with the mixed metals, brass or bronze, and to them we will confine our attention.

Iron, whether cast or wrought, becomes rusted on exposure to the air or water under certain conditions; that is to say, the outer portions of the metal are converted into a hydrous oxide, and can be detached in scales, or flakes. Many systems have been proposed to obviate the danger and many substances applied to correct the evil arising from this cause, full information concerning which, is contained in Mr. Robert Mallet's papers in the Transactions of the British Association for the Advancement of Science. His experiments appear to show that gas tar applied hot is the most efficacious for iron work exposed to cold water; and that a coating of caoutchouc varnish resists the longest in hot water; but that neither of them can be considered a durable defence. Cases cited by M. Vicat are within the knowledge of every architect who has examined this class of phenomena, which prove that in some waters, as in some positions in the open air, iron work, totally unprotected, will last an indefinite period. These exceptions are, nevertheless, so rare, and the destruction of iron unprotected is generally so rapid, both in air and in water, that constant care and attention are required to guard against the destructive tendencies of those agents. If iron work be exposed to the air in positions which render the renewal of the latter difficult, and at the same time retain it in a marked degree of dryness, the iron will become covered with a coat of rust, through which the atmosphere cannot penetrate to attack the metal beneath. If the water, in which iron is immersed, contains a very small portion of some of the earthy salts, the decomposition will take place slowly. But it is necessary to observe that these remarks only apply to iron of considerable dimensions: small wires decay rapidly on exposure to either of these causes of disintegration.

Should iron, however, be exposed to confined air in damp positions, the decay attains its maximum. Carbonic acid gas contributes much to this, for, under its influence, iron passes (to use the words of Vicat) into the state of the carbonate of protoxide, which, absorbing fresh doses of oxygen, transforms itself into a hydrated peroxide. It is indeed generally considered that oxidation cannot take place to a dangerous extent unless carbonic acid be present; and it is precisely for this reason that iron, bedded in fresh masonry or concrete, resists the action of the air, because either the mortar absorbs the carbonic gas, which has a greater affinity for lime than it has for iron, or the masonry is sufficiently dense to protect the iron from contact with the atmosphere. The investigations of the Commission in 1850, respecting the fall of the bridge over the Maine, at Angers, (recorded in les Annales des Ponts et Chaussées, vol. 29, 2nd series, page 394) appear to prove that the preservative action of the lime depends upon its being in immediate contact with the iron, and that if a space, however small, be left between the two substances, moisture will insinuate itself, and in course of time produce active oxidation. M. Vicat, in a note inserted in the Annales des Ponts et Chaussées for May and June, 1853, appears to doubt the correctness of this conclusion, but even he admits that the preservative action of the lime depends upon its absorption of carbonic acid gas, and that directly its hardening ceases, it loses its power of resisting the action of the atmosphere on the iron.

M. Payen found that the addition of very small quantities of the sub-carbonate of potassa, or of sodium, to pure water, was sufficient to render it innocuous either to cast or wrought iron, and the same property existed in nearly all alkaline solutions; whilst, on the contrary, the addition of a small quantity of the chloride of sodium rendered the process of oxidation much more rapid than it usually is in pure water. It appears that grey cast iron is more susceptible of destruction by oxidation than

either wrought iron, or white cast iron; and that wrought iron resists the action of sea water more effectually than cast. It is a peculiar fact connected with this subject, that iron, exposed to frequent displacements, shocks, or vibrations, is less affected by oxidation than when it remains constantly in one place, without disturbance. Thus, anchors in constant use are less exposed to rust than those preserved in the magazine; the rails of the main-lines of railroads are less corroded than those in the sidings; iron steamers rust less when in active service than when in dock. But the positions in which iron decomposes with the greatest rapidity, are those where it is fixed, and alternately exposed to the air and immersed in sea water. Ammoniacal and sulphuric acid gas exercise very serious effects upon the durability of cast and wrought iron. It is important, therefore, to prevent their use, either in urinals, roofs over gas works, or the engine sheds of railway stations. There appears also to be some danger in using iron in contact with sulphate of lime, or in fact under any circumstances where it is likely to take up sulphuric acid gas, for which it has great affinity.

The galvanization of iron, which, as generally practised, consists in forming a superficial coating upon the metal by immersing it in melted zinc, appears to constitute an efficient protection, so long as the iron is covered. The contact with the zinc brings the iron into an electro-negative state, and it is known that, so long as the latter prevails, there is little tendency on the part of the iron to combine with oxygen. From a series of experiments made at Brest between the years 1842 and 1851, (see note by M. Dehargne, Annales des Ponts et Chaussées, 1851) it appears that the zincing process does not, in any sensible degree, affect the tenacity or the ductility of the iron; but it is important to secure the protected metal from any shocks, or friction, likely to remove the surface.

Zinc, when exposed to the atmosphere in its ordinary state, becomes rapidly covered by a whitish efflorescence, which adheres to the metal, and forms, as it were, a species of varnish, capable of arresting any further decay. This efflorescence is considered to be a carbonate of zinc; but if the atmosphere should contain any sulphuric or hydro-chloric acid, (as in London and in the immediate neighbourhood of the sea,) compounds are formed of a nature to compromise the solidity of the metal. In the purer atmosphere of Paris, and other continental towns, where wood is the ordinary fuel, and to which the sea air does not reach, zinc is employed successfully for roofing purposes; in London, and on the sea shore, its durability is very limited; and at all times its combustibility must be a serious objection to its use externally, especially for roofs.

Copper resists the action of the atmosphere very successfully, and the presence of some of the gases mentioned above does not seem to affect it in any material degree. A film of oxide, or carbonate of copper, is rapidly formed over the surface, and secures the metal from further decay. It is found, however, that a mixed metal or bronze, made of copper and zinc, resists the influence of the atmosphere, and sea water, more successfully than pure copper alone.

Lead undergoes little change upon exposure either to air or water, especially when the latter contains small proportions of the salts of lime. According to Brande, when lead is kept in distilled water, to which air has access, small crystalline scales of oxide of lead are formed, a portion of which dissolves in the water, and is again slowly precipitated in the form of a carbonate. Soft water also, or that without the salts of lime, appears to be more likely to attack lead than that containing lime. The use of lead for cisterns must, therefore, be regulated by the nature of the water to be preserved in them; for all roofing or analagous purposes, there do not appear to exist any philosophical reasons to object to the use of this metal, or to limit its application to any particular districts.

A very important remark with respect to the use of metals must be made: viz., that when

two of them are used in contact in positions where moisture, in any form, has access to them, a species of galvanic action is established, which causes them to decay with great rapidity. Illustrations of this may be observed in iron railings, when the bars are secured to the stone curb with lead, and the decay is most evident when the iron is of the best and most malleable description. A similar phenomenon may also be observed when copper, or bronze, is in contact with iron in sea water; though the iron decays rapidly, it appears to exercise a protective influence upon the copper.

The laws of electricity developed by the contact of two metals with a liquid containing a solution of an alkaline salt, are treated at some length in vol. 1, Gmelin's Hand-book of Chemistry, p. 364. From this authority it appears that zinc, tin, and iron, protect copper in sea water. Zinc protects iron and tin plate, but it is not so effective for the defence of iron in sea water if air be present, and it is itself rapidly corroded when used with iron in the sea. In that element tinned iron decays unequally, the iron oxidating whilst the tin remains intact; and it appears that the decay, superinduced by the contact with tin, is greater than that resulting from the contact with copper. The corrosion of copper may be considerably retarded by fastening to it at several points pieces of cast or wrought iron, or of zinc, when sulphuretted hydrogen is likely to be present. Water containing bicarbonate of lime will deposit the lime if placed in contact with zinc and copper, the deposit taking place upon the copper; and when water of this description flows through leaden pipes, the carbonate of lime is deposited at the solder joints (composed of an alloy of tin and lead), on the brass cocks, and on any piece of iron or silver which may be introduced. The inconvenience arising from the stoppage thus produced may be obviated by the use of a lateral pipe fitted to the main at intervals, and furnished with plugs of a metal likely to deposit the calcareous matter, which can thus be withdrawn from the main.

The class of atmospheric influences included under the term medial action in the early part of this paper acts more powerfully upon some of the metals than on other building materials. Thus the tenacity of the former increases or diminishes with the temperature, and the electrical state of the atmosphere frequently modifies their powers of resistance. The most elaborate observations which have been made on this subject have been exclusively connected with the changes superinduced in iron, perhaps on account of its more general employment. They are to be found in Mr. Fairbairn's Treatise on the Application of Cast and Wrought Iron, and in a communication by M. Wertheim to the Annales de Chimie et Physique (3rd series, vol. 12) from both of which it appears that the coefficient of resistance of the metal diminishes with an increase of temperature in a more rapid proportion than the dilatation. Below and near the freezing point cast iron becomes exceedingly brittle, but between about 40° and about 120°. Fahrenheit there does not appear to be much change in its elastic powers. The lineal dilatation of metals, and indeed of all building materials, requires to be carefully attended to in all constructions. Very useful tables upon the subject are to be found in Weale's Engineers' and Contractors' Pocket-book for 1854, and in the Annuaire du Bureau des Longitudes.

Glass under certain circumstances is affected by the action of the atmosphere, for the potash and soda employed in its manufacture are susceptible of being decomposed and removed by the moisture, or the gases contained in it; and according to Gmelin the decomposition takes place with greater ease in proportion as the glass is richer in the above-named alkalies, and the temperature of the moisture or water is higher. Glass in which there is a deficiency of silica is exposed to this description of decay, which may often be distinctly perceived in window glass, the alkali from which is gradually attracted (Knapp's Applied Chemistry, vol. 2, p. 8) by atmospheric moisture and washed away, whilst a thin layer of silica or silicate of lime remains upon the surface and

exhibits a play of prismatic colours. An analagous decomposition takes place in the glass used in stables in consequence of the ammoniacal gases; and, according to Knapp, glass containing oxide of lead is liable to blacken on exposure to air impregnated with sulphuretted hydrogen.

The chemical changes produced in oleaginous and metallic pigments by the gases contained in the atmosphere are subjects of the highest importance to the decorative artist, but as the examination of them would extend this paper too far beyond the usual limits, I must refer the architect who would investigate them to the researches of M. Chevreul in the Memoires de l'Académie des Sciences, 1850 (vol. 22). I may, however, state that M. Chevreul attributes the solidification of paints to the oils they contain absorbing oxygen from the atmosphere, and states that the driers act by facilitating the power of absorption. The various substances introduced to communicate colour appear to affect the rate of absortion; and the surfaces upon which the paints are applied have an influence independant of their mere capacity of taking up moisture. The varieties in the rates of drying upon the several woods and metals, experimented upon by M. Chevreul, indicate some peculiar differences in this respect, which have not hitherto been sufficiently examined.

The consideration of the numerous topics of interest contained in Mr. Burnell's paper was deferred to another opportunity, and the thanks of the meeting having been presented to that gentleman, the members adjourned.

OMISSIONS IN THE DISCUSSION OF MAY 15th, 1854.

The CHAIRMAN asked Mr. Morewood, what would be the cost of the two tunnel sewers carrying off not only the ordinary sewage water, 70 millions of gallons daily, but 270 millions. Mr. Morewood replied, that the contract was ready to be taken at one million sterling. He also said, that the Metropolitan and City Commissioners of Sewers had added to the two tunnels several high level sewers for storm waters, involving an extra cost of two millions sterling, and hence declared that three millions were required for "main drainage." In opposition to this, he stated that the surveyor to the City Commission had himself told him twelve months ago, that the two tunnel sewers as proposed, would carry off every thing except on twelve or thirteen days, during which storm waters would pass through the present channels into the Thames.

Mr. Morewood having also stated that Sir William Cubitt had given in evidence: "Three quarters of an inch of rain fell yesterday, and we saw nothing of it; in twelve hours there was nothing seen of it, it made no disturbance at all,"—urged that a rainfall of 23 to 27 inches, during 150 or 190 days, did not admit of a frequent fall of $\frac{3}{4}$ of an inch, and that a still greater fall was extremely rare and partial. Under these circumstances he expressed his astonishment that the Commissioners of Sewers had proposed to spend two millions for such high level sewers, to provide for storm waters. He declared that the intercepting sewers to pass in the bank of the Thames formerly suggested were impracticable, as the levels would not admit of their discharging the sewage.

In answer to the objection that the Metropolis should not depend upon an artificial removal of sewage water; he stated that the water daily converted into sewage, was artificially supplied, and when steam engines ceased to be able to pump up the sewage in the marshes, east of London, they would also cease to supply the inhabitants with water; a high level sewer costing £500,000. would only save an annual expense of £4000. for pumping and would entail consequences which had been entirely overlooked.

The Great London Drainage Company's Bill proposed government controul, supervision and audit. The guarantee of a contingent 3 per cent. was only asked on one million sterling; £37,000. were deposited as security—impounding of money was suggested by the promoters, and also that the 3 per cent. should only be paid, provided the works were completed within a certain period.

ON ARCHITECTURE AS REPRESENTED IN PICTURES.

By H. Twining, Esq.

Read at the Ordinary General Meeting of the Royal Institute of British Architects, June 12th, 1854.

Considering the extensive field for enquiry presented by the subject of my communication, I should feel much diffidence in introducing it, did I not in a great measure rely upon the observations, which your superior knowledge of architecture will enable you to make on those points which my paper may suggest, and thus impart to it a degree of interest and usefulness which might otherwise be wanting.

In the first place, pictures exhibit in a convenient manner for study, the different styles of architecture in direct connection with different kinds of scenery. (This point was illustrated by engravings of Indian edifices by Daniell). As we are thus enabled to appreciate the relation of architectural buildings to the climate and character of different countries, we have great facility in selecting those styles or orders of architecture which are best adapted to the scenery, as well as the climate and conditions of our own country. Moreover the architecture which adorns pictures is exempt from those trammels which considerations of economy and site, and other hindrances, impose on the work of the architect; and it therefore possesses every facility and advantage for realising the kind of edifice which, in the mind of the artist, appears most consistent and becoming.

As the kind of embellishment which architecture supplies for historical pictures was more resorted too formerly, than at the present time, it is by considering the old masters that interesting facts may be chiefly elicited. One of the most striking points in connection with this subject is, that architecture seems to have been generally treated by them as a somewhat conventional ornament, adapted to the effect of the picture, but without reference either to the country, or to the period of the event represented. The style of architecture most usually selected was the classic, which is frequently brought into connection with events taken from the Scriptures, and which therefore occured chiefly in Judea. But notwithstanding the impropriety of introducing the classic style of architecture into subjects which are entirely Eastern, the association of the simpler orders of such architecture with scriptural subjects does not strike so offensively as might be expected, a proof, it may be considered, that this style is remarkable for its great purity, and for its suitableness for all dignified or elevated subjects.

It would be difficult to believe that the Saracenic, the Renaissance, or any other elaborate style of architecture, could by any contrivance be made to associate with events so solemn, and at the same time so decidedly local, as those which are borrowed from Scripture.

Raphael was one of the Italian masters who had most recourse to architecture for the embellishment of his pictures; and although he did not always avoid the inconsistencies and anachronisms which contemporary artists were apt to commit, he showed an attention to circumstantial facts and particulars which very few equalled. One of the earliest and most beautiful of his works, known as "The Marriage of the Virgin Mary," now in the gallery of Milan, is adorned by an elegant building of sixteen sides with Ionic columns, probably intended for a synagogue, but not having anything Eastern in its style. Its appearance has however nothing offensive, but affords a pleasing accessory to this beautiful subject. In his painting of "Paul and Barnabas at Lystra," this great artist has shown the same attention to circumstantial details, and with the happiest results; for amongst

the statues which decorate noble edifices, the statue of Mercury appears conspicuous, reminding the observer, at once, that the inhabitants believed St. Paul himself to be that God; and that they were about to offer sacrifice to him as such; it is plain how much the historical account is elucidated by such particulars. "St. Paul preaching at the Areopagus at Athens," likewise affords a successful proof how much Raphael enhanced the beauty of his historical pictures by means of tasteful architectural buildings, of which the classic orders, clearly defined, are perfectly and appropriately characteristic. In another picture (of which the cartoon is at Hampton Court) representing St. Peter and St. John healing the lame man at the gate of the temple which was called "Beautiful," he has introduced a number of spiral columns, richly and elaborately decorated; by which means he has marked impressively the characteristic splendour of the porch. But in this instance his attention to particulars does not appear to have been equally successful, for the effect is meretricious, and detracts from the solemnity of the subject. A simpler style of architecture, though perhaps less truthful, might have been better suited to the dignity of the composition.

Neither Michael Angelo nor Leonardo da Vinci, although the first was an architect, and the second an engineer, seems to have resorted much to architecture for the embellishment of their pictures. Nor did Correggio, who at Parma contributed so much by his frescoes to embellish the Duomo, avail himself of the beauties of architecture to enrich his most graceful subjects. The Venetian school of painting, however, borrowed a great deal from the sister art; and in this we may probably mark the influence of the architectural magnificence of the city.

Gentile Bellini was one of the earliest masters who painted architectural subjects; and during his residence at Constantinople he executed a large, and, at the same time, elaborate and highly finished picture of the church of Santa Sophia, which is now in the gallery of Milan.

Another picture of the Venetian school, very remarkable for its architectural interest, represents what was termed the "Miracle of the Ring," so famous in the Venetian annals. It was painted by Paris Bordone, and the back-ground represents the beautiful and highly decorative architecture of the Palazzo Ducale almost as it now stands. But the artist of this school who gave the greatest importance to architectural ornament in his pictures was Paul Veronese. By the introduction of architectural monuments on a large scale he imparted great beauty and originality to his pictures. He often gave perspective depth and greatness to his compositions by representing these edifices at various distances. Further, by placing them on the most diversified situations he added in a remarkable degree to their picturesqueness. These architectural arrangements afforded him the means of diversifying the positions and attitudes of his figures, which he represented alternately ascending flights of steps, leaning over elevated balconies, or climbing up buildings, in order to overlook the principal scene of action.

The Dutch and Flemish, as well as the French painters, usually showed the same disregard for a style of architecture in accordance with Eastern subjects, as did the Italians. For instance, Rubens, notwithstanding his extensive information, and his high position in society, introduced the Doric order of architecture in connection with "The Murder of the Innocents." Nicholas Poussin, who largely availed himself of the advantages afforded by architecture, introduced columns, apparently of the Corinthian or Ionic orders, in paintings of David and Goliath. "The Murder of the Innocents" by Le Brun, now in the gallery at Dulwich, is likewise enriched by edifices of Roman structure, having columns of the Corinthian order. We might have expected rather more antiquarian knowledge or attention to facts, from so eminent and comparatively modern an artist.

But it is especially as an embellishment to the landscape that architecture attains the highest value, and often ennobles scenes which without such ornaments would appear tame or trivial.

Among the landscape painters, Claude de Lorraine availed himself most effectually of the resources which architectural subjects afford; and by the frequent introduction of temples, arcades, palaces, and other buildings, into his landscapes, he imparted to them an elegance, and an air of classic dignity, which it would perhaps have been impossible to attain without the elevating influence of this class of accessories.

The two Poussins were especially fond of that kind of embellishment which is furnished by architecture; and Gaspar Poussin, who was essentially a landscape painter, added by such means greatly to the interest and character of his landscapes. For instance, he marked the strength of any lofty situation by walls and fortifications; the particular aptitude of any site for being inhabited by a large and populous city; and the loneliness of a retired spot by tombs, obelisks, and mausoleums. He thus stamped more impressively the local character of each subject.

The Dutch landscape painters; as Poelemburgh, Berghem, and Loutherburgh, introduced buildings and monuments chiefly as ruins, in which forlorn, but venerable condition, these greatly enhanced their small pictures. But there is a class of artists, who instead of making architectural buildings serve as an ornament to their landscapes, completely spoilt their compositions by great abuse of the resources which it affords. Amongst these may be mentioned, Marco Ricci, Lingelbach, and sometimes Panini. They availed themselves of their sojourn in Rome to copy the numerous monuments of various periods which there abound. This they did, however, without taste and discernment; and in their pictures they introduced promiscuously, and in the greatest confusion, monuments of different periods, of different styles of architecture, indeed of the most opposite character, accumulating these incongruous elements with a confused profusion of which Rome itself does not afford an example. In some instances they rendered this heterogeneous assemblage more ludicrous by intermingling figures of different dates and costumes with the ruins.

Modern landscape painters have devoted themselves more exclusively to nature herself, and have availed themselves generally in a less degree of such means of embellishment as architectural buildings afford. However the French marine artist of the last century, Joseph Vernet, frequently introduced architectural buildings, especially light-houses, bridges, and aqueducts, with great taste and effect; and his English contemporary Wilson realised corresponding advantages by the ruins of such monuments. I need not remark that the late Turner, when not lead by the fascinations of colour to neglect the resources of ornamental form, availed himself most advantageously of the decorative beauty of architecture in his landscapes, as may be seen by the grace and elegance which his picture representing "The building of Carthage" derives from its architectural monuments. We are aware that John Martin so completely commanded the resources of architecture that he thereby imparted a character of combined splendour and vastness to his compositions. In some of his pictures ancient cities surprise the observer by their extent, their remarkable situation, and the originality of the buildings. In others, as in "The Feast of Belshazzar," it is the magnitude of the palaces, and other edifices, which causes our admiration. In these subjects a style of architecture has been adopted, which though to some extent ideal, at least carries the mind at once to the time and the place of the event recorded, an attempt which had not been made by the landscape painters of olden times; and which, although till lately quite new in this branch of art, Martin carried out with the most complete success.

Mr. Donaldson, Hon. Sec. For. Cor., considered that the painters who had introduced architectural subjects into their pictures might be divided into two classes: the first were real painters of buildings, such as Canaletto and Panini; the others, as Raphael, treated architecture merely in the light of an accessory, and to give contrast, by the repose of the structural masses, to the violent action and bustle of the figures. The Venetian School afforded good examples of the second class. It was obvious that though Raphael had exercised great thought and discretion in such accessories, he had committed some incongruities, as in representing strictly Roman architecture in buildings forming the background of the cartoon of St. Paul preaching at Athens. The introduction of architectural subjects into pictures might naturally have taken place in a city like Rome, abounding in ancient remains, which would work on the imagination of the great men composing the brotherhood of practitioners in art which existed there in the fifteenth century. Michael Angelo was an architect by accident—painting and sculpture were more especially his forte,—and his particular case, Mr. Donaldson would adduce as a reason why he entirely disagreed with Mr. Ruskin as to painter architects alone deserving the palm of excellence; Palladio, Sanmichele, and Brunelleschi, on the contrary, were highly successful as architects,—great play of contrasts was exhibited in their works—but they were not painters. The Beautiful Gate of the Temple shewn in one of the cartoons, might perhaps have been more correctly shewn with columns of Egyptian character, but it might be supposed that Raphael was himself ignorant of the real architecture of the place which he had undertaken to represent. Claude, on the contrary, introduced subjects taken from Italian ruins, finely grouped, and with great propriety, into his landscapes, and his example had been followed by our countryman Turner, who, by desiring to have one of his pictures hung between two by Claude, in the National Gallery, had evidently implied the estimate on which he set his own painting; and yet it should be remembered that Turner had accomplished no more than Claude had between 200 and 300 years previously, without any predecessor to instruct him, from whose productions he could obtain hints, and learn to avoid errors. To Claude, innate taste and the study of nature had alone been assistants. The value to a painter of having seen and studied the antient remains in Italy might be seen in the productions of Wilson the landscape painter. The training necessary to render an artist a good scene painter, in respect to treating architectural subjects with strict correctness, had produced good landscape painters in the persons of Stanfield and Roberts. The views of Daniell on the walls afforded a great lesson in the happy manner in which Indian architecture was composed and grouped to harmonize in all respects with nature—the deep shady verandahs and colonnades, surrounded by groves, and enlivened by cool fountains and glittering minarets, vieing, as it were, with the beauty of the Eastern climate. Mr. Donaldson felt that the Meeting were highly indebted to Mr. Twining for calling their attention to so interesting a subject.

The Rev. R. Burgess, Hon. Mem., offered some remarks on the anachronisms observable, not only in the architectural accessories, but also in the dress and character represented in paintings in Italy, even in those of a late period. The ancient masters were no doubt ignorant of the architecture of foreign countries; still there would appear to be something arbitrary in these anachronisms, for which it was difficult to assign any good reason. In this respect modern painters had great advantages; modern discoveries have brought to light the knowledge of Assyrian art for instance, with which the ancient masters were totally unacquainted. Modern painters, then, should imitate the beauties generally, and not the ignorance of the latter, in these matters.

Mr. Donaldson mentioned the fact of Garrick having performed the part of Macbeth in the costume of his own time: and Mr. Scoles, Hon.Sec., said that Northcote had excused himself for instructing his pupil to copy armour of the time of the Commonwealth in a painting representing a classic subject,

by saying, it is better to copy what we can paint well, than to attempt what we do not know. Turner's skill in introducing architectural subjects into his pictures might arise from the knowledge he had obtained in the office of an architect (the late Mr. Bonomi), where he was in fact employed to put in back ground to the drawings. The architecture introduced in the cartoon representing the Beautiful Gate of the Temple, might not be so erroneous as had been supposed, as it should be remembered that Jerusalem, at the time represented, had been for years under Roman dominion, and that the gate in question was probably a comparatively recent construction.

Mr. Papworth, Fellow, had the impression that Raphael was said to have represented the Beautiful Gate in conformity with a tradition concerning its structure. Some of the most effective compositions of architectural subjects in pictures had been produced by artists who were strictly scene painters, such as Bibiena, the Quadratisti, and Servandoni, celebrated for his designs for fêtes,— while even architects, as Novosielski, Soane, and Smirke, had furnished designs for scenic decorations,—Turner, in early life, had made numerous accurate drawings for architectural and topographical publications.

Mr. C. H. Smith, Visitor, said that though the great masters had committed such anachronisms in buildings and costumes, men of less note were often free from such faults. James Barry, in his painting of the Olympic Victors, on the walls of the Society of Arts in the Adelphi, had correctly represented a Greek temple, and the peculiar Greek head dress, before the publication of Stuart's work on Athens, and the acquisition by the government of the Elgin marbles had given accurate information on these points. Unfortunately, painters were apt to neglect the rules of perspective, and hence they could not grapple with architectural drawing. From this stricture he must, however, except the accomplished painter of the picture known as Byron's Dream, in which the celebrated temple at Egina was correctly and happily introduced.

Mr. F. C. Penrose, V.P., Chairman, with respect to the anachronisms of the old masters, thought that they did not strain their imagination to produce representations of objects which were of necessity uncertain and beyond their reach. All the knowledge we possess should be brought to bear on the subject, but in the present day, entering into too much detail caused artists to lose sight of the main object by overscrupulous attempts at accessories, as might be seen in some paintings in the exhibition of the Royal Academy. Architecture had suffered from the incursions of painters, and it should be remembered, in opposition to the dictum of a modern writer, that some of the most eminent architects of the revival—as Sanmichele, Bramante, Brunelleschi, and Palladio, were *not* painters. The beauty of Claude's architectural subjects was generally acknowledged, and the book bearing his name, called the Liber Veritatis, contained numerous excellent *motivi* connected with the subject of such accessories in landscape painting. For painting, generally, classic architecture would seem to be best adapted, its broad masses and repose telling well in contrast with the movement of the figures. At the same time it should not be forgotten that a most perfect specimen of the good effect produced by Gothic architecture, as an accessory, was to be seen in a painting by Van Eyk, in the Dresden Gallery, and that Raphael, in his early paintings, and his master, Perugino, introduced distant views of what might be called imaginative Gothic towers and spires. Mr. Penrose concluded by conveying the thanks of the Meeting to Mr. Twining, and the Members adjourned.

ON THE TOPOGRAPHY AND ANTIQUITIES OF CONSTANTINOPLE.

By the Rev. R. Burgess, B.D., Honorary Member.

Read at the Ordinary General Meeting of the Royal Institute of British Architects, June 26th, 1854.

I have some doubts as to the success of this experiment which I am about to make upon the patience and intelligence of this Institute. Through a succession of seasons I have been indulged with a hearing once a year, and the scene of my antiquarian excursions has hitherto been limited to the ancient Metropolis of the Western Empire. Events which occupy the mind of Europe, rather than any particular wish of our own, have transported us to the shores of the Bosphorus, and perched us, in spite of ourselves, upon the heights of Scutari. But in launching forth from the Tiber to the untried waters of the Bosphorus, I do not navigate without chart and compass, nor am I about to describe a city I have never seen. It was my lot in 1834 to cast anchor in the Perami, and wander for some days about the Bosphorus and the Euxine Sea. It is the result of my poor researches into the Topography and Antiquities of Constantinople that I propose to give you this evening. I shall endeavour to make my paper consistent with the requirements of these conversazioni. I must bear in mind that I read a paper at the Royal Institute of British Architects, who, though not averse to an occasional reference to the modern city, will naturally look for the vestiges of those works which were made under the Greek Emperors before the Arts declined, and ere Classic Architecture fell before Mosques and Minarets,—we must begin with a page of ancient story.

658 years B. C. the navigator Byzas, said to be the son of Neptune, arrived at the Eastern promontory of Europe, and there he founded the celebrated city which was called after his own name, Byzantium; its first inhabitants were probably not much better than the followers of Romulus. They seem to have been the Bashi Bazouks of those early days, which we may freely translate to signify plundering rascals. The situation of this city was admirably selected, and it enabled the Byzantines to check the kings of Bithynia, and to fight with success against Philip of Macedon, and to stem for awhile the inundations of the Gauls when they rushed into the centre of Asia Minor. Pausanias, the Spartan General, after the defeat of Xerxes, fortified the place, and I shall shortly point out the limited space which was occupied by the original city. The advantageous position of Byzantium was soon discerned by the Roman Emperors. It is thought that Augustus conceived the idea of transferring the seat of Government to the Bosphorus, and not improbably the splendid Ode, Lib. iii. Ode 3, which proclaims the vengeance of Juno upon the attempt, was written by Horace with the view of deterring the Emperor from the audacious enterprize. 300 years elapsed, and then Diocletian revived the idea of fixing the seat of Empire nearer to Asia. The first Christian Emperor determined to carry the plan into effect, and he drew the line of his fortifications within sight of the scene of his good fortune. It was at Chrysopolis (now Scutari) where he gained his final victory over his rival for Empire, which made him the undisputed master of the Roman World. When Constantine began to build the city which still bears his name, he found an ample supply of materials within a few hours reach. The forests of the Black Sea furnished him with wood, the neighbouring island of Proconnesus afforded abundance of marble, the cities of Greece and Asia gave up the works of Phidias, Lysippus, and Praxatiles, and even Rome contributed of its stores of art to embellish the new capital; it was finished and dedicated in 334. 150 years after, during the reign of Arcadius and Honorius, who divided the Empire between them, a catalogue was made of all the public buildings in each quarter, like the regionaries of Victor and Rufus at Rome. This document is extant, and is known under the title of the "Notitia;" the author is unknown. It was first published by Guido Panciroli, and it

helped Gyllius to find his way in the comparative Topograpy of the two capitals of the Roman Empire. But Constantinople received a considerable addition to its extent under Theodosius II., 413, as I shall have occasion to point out when we come to make the circuit. Another portion added by Heraclius in 620, must also be taken into account before we get the whole of what is now enclosed by the triple wall of Stamboul. The lively waters of the Bosphorus, after rushing out of the Euxine Sea and flowing in a winding channel for 20 miles, break against a triangular shaped promontory, which forms the Eastern extremity of Europe. They are then parted into the Propontis and the Canal of Perami, which forms the magnificent harbour of Stamboul. The ancients compared this canal, with its winding branches, to a stag's horn, and it is called by Strabo the Horn of the Byzantines; but the antlers are now broken off. It is capable of containing 1,200 ships of the largest size. On the side of the Horn opposite to Galata rise the mosques and habitations of Constantinople. The city is a triangular figure, about 13 miles in perimeter, along a shore extending from East to North to a distance of 3 miles, forming *one* side of the triangle. There were anciently twelve gates which opened upon the Port, most of them still remain in their original sites, and retain their ancient names in the present Turkish designations,—the one at the Seraglio Point, called the Porta Eugenii, (*a*)—another, nearly opposite St. Sophia, called Porta Neoria, or Naval Gate (*b*), and now in Turkish, Tchifout Capoussi, are no longer in use. It was from the Porta Navalis that the chain was suspended which (drawn across to what is now Galata) shut up the entrance into the Golden Horn. I have in former times fought so many battles over the Gates of Romulus, which, after all, may never have existed, that I should feel reluctant to engage either you or myself in a controversy about the names of the Gates of Constantine, particularly as we should have not only to cope with various readings of Greek, but to adjust the value of a Turkish translation. To proceed with our Gates.—No. 1. Ghemi Iskelè, or the Fruit Gate, called also Zindan Capoussi; it was anciently called the πυλη των καραβιων, or Gate of Boats, and it is at this time the principal landing place for the caiques crossing the port from Pera. No. 2. Oun Kapaneu Capoussi, anciently the Porta Farinaria, the gate by which the corn was taken into the city; it is now closed. No. 3. Djubali Capoussi, or the Glazier's Gate. I cannot find an ancient name for this. No. 4. Aia Capoussi, that is πυλη αγια, the Holy Gate, so called because the people landed there to go to the Church of S. Theodosia; and it is remarkable that the Turks should have annexed the Greek adjective αια, or αγια, holy, to their Turkish substantive of Capoussi. We come now to the Fanar, which is the quarter of the city that has been inhabited by the Greek princes and nobles ever since the fall of the Greek Empire. The heroes, descendants of the Cantecuzene and Palæologi, who went forth to fight for freedom in 1820, were principally Fanariotes. The Fanar Gate is still called by the Turks, No. 5. Petri Capoussi, or the Gate of Peter. Indeed the whole district was named after the Apostle of the circumcision. The Regio Petri is celebrated in the seige of Constantinople, 1453. When Mahmoud II. had transported his light ships overland from the Bosphorus, not being able to force the chain drawn across from the Porta Neoria, he launched his boats nearly opposite the Gate of Peter. Notaras defended the gate with great valour, but his abject submission to the conqueror afterwards, tarnished his renown. If he had had a single screw steamer, the multitude of light ships which had been carried over the heights of Pera had never shaken the Gate of the Fanar. This gate, like all the rest on the port, is narrow and low, a mere opening in the curtain of the wall; just within it stands the house of the Greek Patriarch, and the Patriarchal Church of St. George, to which we shall again recur. No. 6 is the Gate which leads to the Jews' quarter, called Balat, which in all probability is a corruption of Palatium, for the gate formerly was the βασιλικη πυλη, or Royal Gate, leading to an imperial residence, of which there are some remains. No. 7 is Haivan Hissari, anciently called Cynegeton, or the Gate of the Vivarium, the place where wild beasts were kept for the use of the amphitheatre, which was situated at this extremity of the city. The Chiloporta (*c*) at the very angle of the city is closed. Before

leaving the enclosure of the Balat, we have the Egree Capoussi (No. 8), anciently called Charsias. Towering above the city walls we see the structure of a building which is called the Palace of Constantine, but ought rather to be called the Palace of Heraclius, for we are now in that portion of the city which was added by that Emperor in 620. From hence we strike across the Continent to pursue the line of walls which stretch from the Perami Canal to the Sea of Marmora, a length of about 4 miles, and forming the base of the triangle or harp, to which may be likened the form of Stamboul. No. 9. The Edrene Capoussi, or Hadrianople Gate, anciently Poliandron, may be considered as the first that occurs in the walls of Theodosius. A few words of general description will be in place here.

These walls present a triple line, and have retained, in a great measure, their original appearance. The inner wall is the highest of the three ranges, and it is strengthened by lofty towers, indifferently square, circular, or octagonal. The second or middle wall is much lower, and the towers less, being generally circular; and the third, or outer wall, with batteries running along the top, serves as the barrier of the ditch or foss that runs before it. "The intervals between those walls are 18 feet wide, and are in many places choked up with earth and masses of fallen ramparts." The materials are almost invariably stone and brick, in alternate courses. The towers in some parts are completely clad with ivy, in others half ruined and half overshadowed by the fig-tree, which has caused the rent, "mala robora ficus." The solitude beneath those ramparts is as complete as it is in the vicinity of the walls of Rome, and it is saddened by the melancholy groves of cypress trees which stand over the Mussulmans' graves. Passing the Edrena Capoussi, we must stop for a few moments at the next, No. 10. It was called S. Romanus, the Turks now call it Top Capoussi, or the Cannon Gate, on account of the great event which took place in 1453. It was here that the last of the Constantines bravely fought and fell before the everpowering force of Mahmoud II.; his body was found after some days under heaps of slain, and was only recognised by the silver eagles upon his slippers;—if ever

The city won for Allah from the Giaour,
The Giaour from Othman's race again may wrest,

the great struggle will be at the Top Capoussi: there the assailants would be beyond the reach of war vessels in the ports, and the heights of Scutari are too distant to afford protection: in short, the whole line of wall, from the Blachernæ to the 7 towers, would require to be covered, if 50,000 Russians should ever cross the Balkan. A little further, and we arrive at the Mevlanè Yeni Gate, No. 11, called in former times Melandisia. It bears upon the long lintel, which rests upon two consols, a Greek inscription, and the following in Latin:—

Theodosi jussis gemino nec mense peracto
Constantinus ovans hæc mænia forma locavit
Tam cito tam stabilem Pallus vix conderet arcem.

No. 12 and 13 are respectively the Selivri and the Kapaneu Gate, anciently the Porta Quintii, and the Porta Attali. We now arrive at the enclosure which surrounds the Golden Gate, and the Yedi Kouleler, No. 14, or Seven Towers. Considering the Seraglio Point, where the Sublime Porte exists, to be the seat of government, we are now at the farthest extremity of the city. Behind the trees which hang from the walls, and flanked by two large square marble towers, is discerned the Porta Aurea, or Golden Gate; this was in fact a triumphal arch built by Theodosius, to commemorate his defeat of Maximus. Compared with similar monuments at Rome, there is nothing remarkable in it for richness of ornament, or elegance of construction: on the top of it stood a statue of Theodosius, which, after being thrown down by an earthquake, was replaced by a statue of victory. The inscription upon it, which is still legible, is this—

Hæc loca Theodosius decorat post fata tyranni
Aurea sæcla gerit qui portam construet auro.

In the time of the Greek Emperors, there was a fortress at this extremity of the walls, it was called Cyclobion. The Latin armies, who attacked Constantinople by the golden gate, destroyed it. John Cantacuzene rebuilt it, but it was in ruins when Bajazet threatened the city. Mahomet II., the Conqueror of Constantinople, finally rebuilt the fortress on the same site, and added several towers. The Greeks called them Heptapirghion. The Turks, Yedi Kouleler, the seven towers. I could only discern four rising conspicuously above the outer walls of the city; in one of those, that nearest the Golden Gate, the foreign ambassadors used to be stowed whenever they displeased the Sultans. The times are changed, and perhaps the Sultans might find a lodging in the same tower, if they chance to displease the foreign ambassadors. This may be called the Bastile of Constantinople. It was within these gloomy walls that Brancovan, Prince of Wallachia, with his wife and four sons, were put to death; while Demetrius Cantemir, who had betrayed the unfortunate Prince, was satiated with the favours of Sultan Achmet. During the French wars, a Russian ambassador, Count de Bucalof, was imprisoned here for nearly two years; also a French ambassador, Rufin, who was severely treated. Even as late as half a century ago, Sir John Arbuthnot was threatened with a lodging in the 7 towers. There might be no objection perhaps to grant a lodging there now to a Russian ambassador. But at present, the successor of Baraguay d'Hilliers and Lord Stratford de Redcliffe, may look at the Yedi Kouleler with as little apprehension as I did on the last day of July, 1834. We have now to run along the third side of the triangle, which extends from the 7 towers to the seraglio, and is washed by the waters of the Propontis. The first gate that occurs is the Gate of the Bombshells, Narleu Kapou (15). The second retains its Greek appellation, Psamatia (16), or the Sandgate, and it gives the name to the quarter of the city to which it immediately leads, in which there is a considerable population of Greeks and Armenians. It contains churches, dedicated to St. Nicolas, St. Polycarp, and St. Basilius: it is probable that St. Nicolas is the least popular at this moment! The walls now recede from the line of shore, and form an angle at the Gate of Daoud Pascha (17), probably the ancient port of S. Emilianus. From here begins a valley which runs across to the Perami, and divides the city of Constantine from that of Theodosius. It is a thinly inhabited quarter, with a towering mosque. Gardens, not warehouses, occupy much of the space, and the whole has the appearance of a Turkish village. The next, that is the fourth gate on this side, is Yeni Capoussi (18), or Newgate. We next arrive at Koum Capoussi (19), another Sandgate; and from here to the Seraglio we obtain in our circuit, glimpses of the original work of Constantine, patched by Genoese, and Venetian construction,—towers built upon rows of columns inserted lengthways, and fragments of marble starting out of crumbling heaps in admired disorder,—this portion of the line of wall which ends at the Tchatladi Capoussi (20), is a faithful representative of the Turkish Empire. Like these walls, it is built up of heterogeneous materials, and fragments kept together by cement got by foreign aid, capable of little resistance, and presenting a motley sort of construction of the Arabesque order. The last gate (21), Akhour Capoussi, or the Stable Gate, so called because it leads to the stables of the Harem, and from it begins the enclosure of the Seraglio. With these mysterious walls we round the promontory which forms the Eastern extremity of Europe, and represents the apex, somewhat flattened, of the triangle whose perimeter we have now measured. Bondelmonte reckons from the angle at Blackernes to the Golden Gate 180 towers; from these to the Cape S. Demetrius 110; and he makes the whole circuit of the walls 18 miles; but this must be meant to include Galata, on the other side of Perami,—a suburb of Constantinople we have yet to describe. In order to proceed with this, I must take you in a light caique from the Seraglio Point, Serai Bournou, across to Tophanè, and we arrive at Galata, to which must be added Pera. These two suburbs separated from the Stamboul of the Turks by the Perami canal or harbour, were possessed by a colony of Genoese. After the holy wars had ceased, at the end of the 13th century, they obtained the suburb as a fief from the elder Andronicus, and they surrounded and fortified it with walls. The Venetians attempted

to wrest it out of the hands of their rivals, but in 1352 the Genoese were victorious. They engrossed the commerce of the East for a century, and their wealth enabled them to overawe the enfeebled power of the Greek empire. They made a struggle against the formidable Mahmoud II., but were involved in the general ruin of Constantinople. The walls of their city have stood unto this day. They run from the artillery barracks of Tophanè, to the mariners, near Cassim Pacha, along the shore of the Perami; they ascend the hill in a zigzag line to the tower of Galata, and descend to the vicinity of the grand mosque of Mahmoud. They are built of small square stones, with numerous fragments of antiquity filling up the voids. The towers are round or square, as it happens, and it appears the colony was governed by a Podestà. I copied this inscription—*Spectabil Nobil Ilarius Imperialis Potas Pere*, but I know nothing more of this respectable noble Ilarius than this inscription. I found the dates 1433—1447 upon the towers, and it was only six years after the latter date that Constantinople was taken by the Turks. This district, now known as Galata, was anciently called the "Regio Sycarum," or the fig trees: in the ancient "Notitia" it is registered as the XIII. Region; and it bears about the same relation to Constantinople proper, as the Trans-Tyberine Region at Rome bears to the seven-hilled city on the left bank of the Tyber. The emperor Honorius built a forum and theatre here, and there was a temple of Amphiaraus, and another of Diana Lucifera. The emperor Justinian joined this region to the main city by a bridge thrown across the harbour, and he gave it the privileges of a municipality, with the name of Justianopolis; but the name is now only to be found in the pages of Procopius. A few broken columns employed in the Genoese houses, or lying in the corner of the streets, are all the vestiges that can be found of the ancient monuments. I need not bring you back to Galata and Pera, for, except the arsenal of Cassim Pacha, we should find few objects worthy of a Cicerone. We now embark again in our light caique at Tophanè, and cross the Bosphorus to the port of Scutari, a distance of two miles. If we ascend to the top of Bourgaloue, we obtain a magnificent view of the cities we have already surveyed. We see into the gulf of Nicomedia, and the eye runs along the Western shore of the Bosphorus; the mountains of Asia appear to fall in azure folds; in the distance we look over the fields of Europe, and catch a view of the Propontis. Chalcedon, now Kadikeu, lies at the foot of the mountains, and the name of St. Euphemia preserves the remembrance of the famous council held in 451, when the heresy of Eutyches, to which the Armenians still adhere, was condemned; the founders of Chalcedon have become immortal in contempt, for having selected so ineligible a position for a city, when they had the promontory before them, on which Byas, with more discerning eye, founded his city thirty years after. But Kadikeu or Chalcedon still serves for our topography, for as the Bosphorus begins to expand its waters into the Propontis it passes between Byzantium and the ancient Chalcedon. From Kadikeu we may ascend to the vast cemetery of Scutari: this is a forest of cypresses, extending for several miles, and in the deep recesses of its gloom are interred the remains of pious Mussulmen of many generations. Every true follower of Mahomet prefers the country of the prophet for his last resting place,—he considers Asia, not Europe, his home,—he believes his mortal remains will be better protected from the profanation of the infidel: but perhaps none of the myriads which now sleep in the dust ever dreamt that some 25,000 Giaours or infidels would, in the year of Hegira 1270, be taking their pastime among the cypress groves of Scutari. This Asiatic suburb, although said to be as large and populous as Smyrna, has more the aspect of a village than a large town, except about the port. I speak of its ordinary appearance, it occupies the site of the ancient Chrysopolis, and was in the time of the Crusades covered with the armies of Godfrey de Boulogne. I have already said that it was upon those heights above the port where Constantine triumphed over the last of his rivals for empire the unfortunate Licinius was taken captive to adorn the triumph of the conqueror. The barracks which are, or have been occupied by the British troops, were originally built by Sultan Selim, and after being burnt in the Janissary war of 1832, were reconstructed as they now exist by the father of

the present Sultan. The gaiety which reigns around the open fields and barracks of Scutari, contrast strangely with the gloom of the sepulchres: life and death appear to go hand in hand. Under the shade of the cypress trees are groups of females in gay attire, resting against the painted turbans on the tombs, and squatting on the graves of their relatious; the merry laugh goes round, and not a thought of gloom appears to cross their revelry. The Arlabats which jingle past are saluted from the tombs as gaily as from the balcony, and the grave which has not yet grown green is the scene of life among the dead. The most imposing tomb I saw was formed of a canopy resting on four columns, covering an ample space; it was the resting place of no distinguished warrior or statesman, but the tomb of Sultan Osman's favourite horse. The great sight at Scutari is the performance of the howling dervishes, but the description of "this religious liberty" I leave to "our own correspondent." We now leave the Asiatic suburb of Constantinople, and for a general survey of the places I have so far described, I shall ask you to accompany me to the top of the Seraskier's tower (F). It stands within the enclosure of the old seraglio, and on the highest ground in Stamboul. From this advantageous position the spectator may trace the outlines of the seven hills on which the city of Constantine, like Rome, was built. The space occupied by those seven hills was divided into thirteen regions, the one on the opposite side of the canal made the fourteenth, although it was the thirteenth in numerical order. The XIV. regions were no doubt in imitation of the internal arrangements of Rome, made by Augustus: by the help of the Notitia, and by the measurements given in it, we may ascertain much of the topography of the ancient city.

THE SEVEN HILLS OF CONSTANTINOPLE.

The number seven is all the resemblance that exists between the hills of Rome and those of Constantinople, no renown hovers above the Byzantine topography, the hills have not even names, and glory has not left so much as her twilight to preserve them from oblivion; they may however be traced, and their outlines be as strongly drawn as the Esquiliæ and Viminal, and the Quirinal of Rome, which is not saying much. A topographical survey of the city of the East, is not complete without them, but I shall do little more than point out to you their positions by citing the most conspicuous buildings which stand upon each. The first may be limited by the Seraglio walls, and comprises all the space on which St. Sophia and its appendages now stand (A); the second may be traced from the Mosque of Sultan Achmet (B), in a line towards the Osmanea (C); and the Bezestein, "the burnt pillar," to which we shall shortly return, stands on the most elevated part of it, and its outline may be followed towards the Propontes at the Tchatladi Capoussee (20); these two hills may be considered as comprising the site of the ancient Byzantium. The third hill is crowned by the splendid Solimanea (E) and its extensive dependencies; it comprises the ground on which stands the Mosque of Sultan Bajazet (D), including the Seraskier's Tower on which we are now supposed to be standing, and reaching to the Validè Han, falls away towards the port. The fourth hill begins with the Aqueduct of Valens, and comprising the ground which rises above the old quarters of the Janissaries, it ascends to Sultan Mahomet's Mosque (G), and turns by the south side of the Fanar into the valley west below the old Seraglio. The fifth hill is distinguished by Sultan Selim's Mosque (L), and comprises all the Fanar down to the Golden Horn. The sixth hill, if hill it may be called, includes about one-third of the entire space within the circuit of the walls, extending lengthways from below the Mosque of Sultan Mahomet to the seven towers. In the year 413 Theodosius enclosed this space, and thirty years after, when the wall had been thrown down by an earthquake, it was restored by the Præfect Cyrus, whose glory so far eclipsed that of Theodosius the younger, that the people proposed to change the name of that part of the city and call it Cyropolis. Theodosius became jealous of the restorer of the walls, and it is said put him within the strong walls of a monastery, after having caused him to be shorn, and there he died of grief. The remaining hill reaches beyond, and comprises the quarter of the

Vincent Brooks Lith. King St. Covent. Garden

TOPOGRAPHY OF CONSTANTINOPLE.

Blachernæ which was left without the walls of Theodosius. The Emperor Heraclius added this to the city, and so entitled it to be called seven-hilled. The most conspicuous object on this seventh hill is Meribos Sultana Djami. I have already remarked, that as there were seven hills, so were there also fourteen regiones; each contained a number of public buildings which are enumerated in the "Notitia," but little remains of any of them to tell the tale, or to give the antiquary the pleasure of disputing. Time, war, fire, and the destructive tendencies of the Turks, have effaced the monuments of former ages, and if we would enjoy the view from the Seraskier Tower, we must invoke the muse of history, rather than the sullen genius of antiquity. We are here on the theatre of the world's exploits. A narrow channel divides Asia from Europe, those two quarters of the world which until modern times had monopolized the human race, and those arts which adorn its existence; the very waters of the Bosphorus are immortalized by deeds consigned to the lasting page of history. Over it once passed the innumerable phalanxes of Darius, the ten thousand warriors of Xenophon, and the crusading hosts of the pious Godfrey; upon it the celebrated Doria destroyed three hostile fleets in a single battle. Beyond it rises the first city in Asia, Scutari, the ancient Chrysopolis; near it, keeping one of the portals of the Propontis, is Kadikeu or Chalcedon, the school of sacred learning, but the scene of religious disorder; around us at our feet are the hills we have just been tracing out, marked by some conspicuous object which tells us we are in the city of the Sultans; the gigantic Mosque of St. Sophia is not entirely despoiled of that reverence which belonged to it in the days of John Chrysostom. The eye runs over the magnificent port crowded with skiffs, and carrying a whole city of souls upon its buoyant waters. Opposite is Galata, the work of the Genoese, once the emporium of the world, and still distinguished by the colossal towers which defend it: the countless habitations continue as far as the view extends, up the Bosphorus and the Canal. On the south glitter, on the Sea of Marmora, the Isles of the Princes, Akalki, Antigone, and Proti, the alluring retreats of the idle and wealthy; and finally the horizon is bounded by the azure tops of 1,000 far-famed hills, amidst which, as a sovereign among his subjects, towers the lofty Olympus. We shall now descend into the streets of Constantinople, and see what the ravages of time and fire have left for the antiquary and the topographer, and what recompense we have under the Mahommedan regime for the loss of our Roman buildings. Constantinople under the reigns of Arcadius and Honorius (who divided the empire between them into East and West, A.D. 380), contained 4,388 houses, besides fourteen extensive palaces or mansions, it contained eight Thermæ or large bath establishments, two basilicas, two forums, two senate houses, two theatres, fifty-two porticoes, 153 private baths, twenty public swimming schools, the purple column, two other honorary columns, and one colossus, a mint, a capitol, four harbours, a circus, together with cisterns, nymphæa, and other objects necessary for a great city; thirteen Curators and sixty-five Vico-magistri had the care of the whole; and there were at that time only fourteen Churches. It will be seen from the above enumeration, that the City of the East bore no comparison to Imperial Rome, either in the splendour or quantity of public edifices. The Goths and Vandals spared more of Rome than the Turks have done of Constantinople, and the basilicas and museums supplied by Popes, have by far outshone in splendour and magnitude the mosques and Hanès of a line of Sultans. The Hippodrome (d) is the first object of antiquity that attracts our notice, and upon its now disfigured arena, "we are met by the shades of Justinian and Belisarius." The Turks call it by a name which denotes its original purpose, Atmeidan, or the place of horses. Septimus Severus first made a circus in the midst of the ancient Byzantium, modelled, no doubt, after the Circus Maximus at Rome, and this afterwards became the Hippodrome; the space which was the arena is yet clear of buildings. Three monuments of antiquity remain in their original positions—1. a half ruined pyramid of stone, which it appears from an inscription was covered with bronze by Constantine Porphyrogenitus. 2. The twisted column of the bronze serpents, and 3. an Egyptian obelisk: all these stand in a line, and I have little doubt they formed some of the ornaments of the Spina; there is a bas-relief on the

obelisk which I take to be a representation of the Spina; from the stone pyramid to the twisted column I measured forty-seven paces, to the obelisk twenty-two; the whole length of the Hippodrome I calculated at 1,000 feet, that is about half the length of the Circus Maximus at Rome. I need not stay to describe the Pyramid of Stones, it is a rude work and merits little observation, but the Twisted Column is one of the most interesting classical monuments in existence; no one ever doubted that this curious relic was brought from the Delphic temple, and was the consecrated offering of the Greeks after the glorious defeat of Xerxes. Gibbon dwells upon this relic with delight, and even his sceptical mind admits that it is genuine. It now stands about eleven feet above ground, three serpents' tails are twisted together into a column, their heads supported the golden tripod, which, of course, has disappeared. Mahmoud with a stroke of his battle-axe broke one of the serpents, and the other two heads have gone with the golden tripod. If this relic were still at Delphi, it might be doubtful, whether it should follow the destiny of the Elgin marbles; but our allies, the Turks, are little curious upon these classical subjects; they have long ago scratched Arabic characters upon the folds of this Delphic column, and in the hollow of the bronze they have amused themselves by inserting stones; under these circumstances, I would encourage the idea of enriching our national depository of antiquities with the Twisted Column, and I should imagine, that a piece of cannon being of equal weight with the bronze, would be considered an ample equivalent for a useless piece of antiquity. The Obelisk was set up in the reign of Theodosius, as it appears from incriptions still legible on the lower plinth of the pedestal; it would occupy me some time if I were to attempt to describe and translate the bas-reliefs, and inscriptions, Greek and Latin, which are seen on the four faces of the Obelisk: I hope the task may be performed by some of our centurions during the vacancy at Constantinople. The four steeds of brass now glowing before St. Mark's at Venice, "their gilded collars glittering in the sun," were taken from this Hippodrome, and most probably stood over the Porta Pompæ, that is the gate by which the processions entered the arena, through the middle of the "Carceres." The factions of the blues and greens, which once shook the walls of this Hippodrome have long since ceased, but the scenes of cruelty and bloodshed of which this arena was the witness, inflicted such a wound on Oriental Christianity, that Mahommedanism had at last an easy victory. The Moslem has now enjoyed his triumph of a thousand years, his dusky wings have overspread the fairest regions of the East.

"While blasted by his crescent's dreadful glare,
The bloom of science and of genius dies!"

There were several triumphal columns in Constantinople, one in honor of Theodosius, which stood on the seventh or most remote hill, and on each side were the statues of Arcadius and Honorius; these are no longer existing, except in the pictures of Gentile Bellini; but near to the Avret Bazaar, there stands a pedestal sustaining the Torus of a column's base, and this was the pillar of Arcadius. Not far from the Shah Zadi Dgiami (M), or Mosque of the Sultan's Son, stands a column called by the Turks "Kistash," or the Virgin's stone (F); the basement and pedestal are of marble, the shaft of granite, and it has suffered by fire; on the upper plinth we can still decipher the three words, *Quod Tatianu sopus:* but the English traveller, Wheeler, read the whole inscription: it was erected to Tatian, by the Emperor Marcian, who ascended the Byzantine throne in 450: the capital is a ponderous weight of marble placed on a tall shaft, and it would require all the skill and knowledge of this Institute to explain the winged figures and the monograms which appear on the capital and the pedestal: such caprices generally mark a period of decline in art and genius, not unlike some authors, who, for want of originality, fill up their pages with inapt quotations, and try to conceal the theft. The Aqueduct of Valens is best seen near the At Bazaar, or horse market; its origin, no doubt, is Roman, but its conspicuous rows of arches are chiefly the patchwork of the Sultans. The next object of antiquity worthy of notice, is the Burnt Pillar, which has attracted the special notice of travellers (e),

it is of porphyry, the shaft composed of several pieces, the jointures concealed by garlands; it is now bound in several places with iron bands to keep together the calcinated pieces loosened by the fire; it is said to have been brought by Constantine from Rome, and on the top was a statue of Apollo; on the upper part is an inscription bearing the name of Manuel Comnenus as the restorer. When Mahmoud II. entered Constantinople, the Greeks had a prophecy, that when the invaders arrived at the Burnt Pillar they would be stopt by the destroying angel; but the prophecy did not come true. Pocock observes, that Arius died near this column; very near to it are the subterraneous cisterns, two of them now dry, and only used for spinning silk and making ropes; in one of them (h), I counted five divisions supported by thirty-two granite columns of perfect symmetry; the second is said to have 1,001 columns, which is just the number of stories in the Arabian Nights Entertainment, but I did not take the trouble to verify the number. There is a third cistern which still serves the original purpose (k), it is called Batan Serai, and Gyllius counted in it 336 columns; it best explains the nature and objects of those large works made by the Greek Emperors for supplying the city with fresh water; they appear to have attracted the attention of our countrymen more than any other object of antiquity, and I can conceive a practical engineer, or even the commissariat, prefering the Cisterns to the Burnt Pillar or the Twisted Column. The rest of the antiquities of Constantinople must be sought for in the walls of Mosques and in the gardens of the inhabitants; fragments of marble are frequently turned into stepping-stones in the street, and pieces of statues inserted into houses; you occasionally stumble over a broken shaft, or you may hurt your shin against the corner of a votive altar, you may fancy you have found an inscription which is to throw light upon your topography, but approaching to read, it turns out to be a verse of the Koran, or Mahommed is his prophet. There is yet, however, much that an antiquary, if he had time and a pickaxe, might evolve out of "the double night of ages and of ignorance;" and perhaps this new sort of a column into which English, French and Turks are twisted now, may lead to some excavations that will bring to light a work of Phidias, or one of the Oboli dropped into the begging bag of Belisarius! I did not profess, in offering this paper to the Institute, to attempt any account or description of the modern buildings of Stamboul, not for want of matter, but for want of time; and in order to maintain a certain consistency with the heading of our conversazione; but before I conclude this paper, I will venture upon two specimens of existing objects respectively belonging to the religion of Turks and Christians, I mean a Mosque and a Church. The Mosque of Sultan Achmet, erected in 1610, is doubtless one of the finest buildings the Turks ever produced, it is the only one that has six minarets. The Osmanea, built by Osmyn III, is also worthy to be mentioned. The Validè, built by the mother of Mahomet IV, is another of the chief Turkish temples, but the Mosque I shall take as a specimen is the one I obtained access to, the Solimanea. The Sultan, Soliman XIV. Emperor of the Turks, was fully entitled by the laws of the Koran to erect a temple, for he had subdued provinces in three out of the four quarters of the world, he was contemporary with Charles V, and struck terror into the European sovereigns. Returning from his conquests of Rhodes and Bagdat, he reared this stately Mosque, where the rules of Mahommedan architecture are strictly followed, it was mainly built out of the spoils of the ancient Chalcedon. A fine quadrangular court, like the cloister of a monastery in form, is supported by ancient columns of granite and porphyry, in the midst is the fountain for the religious ablutions of the Musselmans; the whole magnitude of the interior is displayed to the eye of the stranger at his first entrance. There are no nefs or subdivisions to obstruct the full comprehension of the whole space enclosed. The dome, supported upon four splendid granite columns, covers the whole space on which we stand, and Pantheon-like gathers and eats up all the air around it. The lamps suspended and crossed in all directions, add as little to the simplicity and dignity of the interior, as the innumerable wax-lights and festoons of the Romans add to their Basilicas. On the side opposite the entrance are several stained glass windows, reported to have been done by some artists from Persia; the colours are rich but generally much deeper than in

our cathedrals. The Keblè, or Caaba, is on the same side: here the chief Mufti says his prayers, on his left he has an elevated pulpit from which he expounds the Koran; opposite this is the seat of the Mollah; these are arranged as systematically as any of our modern Sedilia. On the right, but not conspicuous, is the Sultan's seat whenever he chooses to pray at the Solimanea; behind the pillars and in the recesses of the walls are seen the worshippers, some praying, and others reading the Koran aloud, copies of which, as our Bibles used to be in days of scarcity, are chained to the walls. We walk round the whole of the interior with shoeless feet upon smooth matting, the Caaba only is carpeted, and a Mollah keeps an eye upon the Giaours and their piastres, as they dare to violate this sanctuary of Ismalism. Near to this Mosque, in a garden, is the Mausoleum of Soliman and his relations, an octagonal building covered by a neat dome, but I must omit the detailed description. The number of Imperial Mosques are seven in all, a remarkable coincidence with the seven Basilicas of Rome; these (I mean the Mosques) are—

S. Sophia.	The Solimanea.
Sultan Mahomed.	Sultan Achmet.
Sultan Selim.	The Osmaynea.

and the Sultan Bajazet.

Except the one of Sultan Achmet, they have all four minarets each, and large groups of cupolas.

As the specimen of a christian place of worship I shall take the patriarchal church of St. George, which stands just within Petri Capoussi, a gate of the Fanar. In entering the court the visitor is seized with a shuddering fit, when he is told that he is passing under the beam to which the aged patriarch Gregory was suspended, in his pontifical robes, on Easter Sunday 1821. The Jews took his body, and with mockery and insult threw it into the canal, mutilated and bleeding. The thrilling effect which this inhuman murder produced throughout Christendom, contributed greatly to the Greek cause, which issued in independence. The interior of the cathedral boasts of no richness of material, but it is kept clean; there is a screen in better taste than in most of the Greek churches. They show the episcopal chair of burnished wood, which is said to be the cathedra of John Chrysostom, but this seems to be too much even for the credulity of an Asiatic Greek christian. The column to which they say the Saviour was bound, is held in greater veneration; the expounder did not seem to be aware that there were several others in the Latin part of the world: the frieze under the gallery is painted by some Italian artist, who, perhaps, followed in the steps of Bellini from Venice. A coarse mosaic of the Virgin, and some ordinary Greek paintings, decorate the walls around the inner sanctuary, and the gilding of the screen is perhaps the richest ornament the Oriental church possesses. This cathedral, for such we must call it, can accommodate 600 or 700 persons at one time, and it is the largest and best conditioned christian temple in Constantinople; close adjoining to it is the patriarch's dwelling, a remarkable contrast with the splendid palaces of his brother of the West, "The most Holy Anthemos" seemed to me to be more happy with one chamber to sleep in, and another in which to drink his coffee, than his more fortunate competitor for sacerdotal dominion, with eleven hundred chambers at the Vatican, and a palace at Castel Gandolfo. But here we pause. I dare not venture up the Bosphorus into the Black Sea, although there are many objects of classical interest which that excursion would afford. If the Peace Society should allow the war to go on for another of your sessions, I shall think it my duty to tell all I know of Beicos Bay, and the fortresses on both sides the stream, built by French engineers during the latter half of last century, perhaps for French artillery to knock down during the present. Constantinople has its Campagna as well as Rome, and the coast of the Euxine Sea is now becoming as celebrated as the Lavinian shores. We do not know what another year may bring forth, but some great change is inevitable, or "where the Russian Ksar

* * * * * * or sultan in Bizance

Turchestan born."—(Milton.)

It is still possible we may have an excavation in Constantinople, and a free admission for Franks into Santa Sophia. The patriarch may possibly get an additional wing to St. George, and the Crescent and the Cross may appear on the same standard which is to wave on the ruins of Sebastopol and avenge Sinope; "sed nos hæc grandia haud conamur," you will not be surprised to hear, "that the weapon which my Spirit yields is of another temper." I have more confidence in a Peace Society which was instituted eighteen centuries ago, and which has been waging war with the powers of evil ever since, but its legitimate weapons are not of steel, nor its artillery of brass and iron; it proposes to overcome, and finally to triumph, by the simple proclamation of "peace on earth and goodwill towards men," and I look forward to the sower going out to sow in peace when the battle of the warrior has ceased. The highway to the East will be made for all nations, and who knows but the Jews may dwell in their own land. The artist may make his cheap excursion in the same steamboat which will carry the biblical student to the land of Armenia; and the architect may still measure the columns which are concealed at Derbe and at Lystra, where the gods were supposed once to have come down in the likeness of men. The gates of Constantinople shall stand open to receive the civilising influences which always follow in the train of the christian missionary, witness New Zealand and Sierra Leone, and the regions round about Abbeokouta. A summer excursion will be more easily made than it was in 1834, when the humble individual who has now tried the patience of his audience, gathered up the materials which have enabled him to compile this paper, chiefly out of his own book, on the Topography and Antiquities of Constantinople.

Mr. T. H. Wyatt, V.P., Chairman, proposed the thanks of the Institute to Mr. Burgess for his brilliant and learned paper, which had lost none of the grace and spirit of his former communications.

Mr. Tite, Fellow, entirely concurred in the eulogium of the chairman. He hoped, however, Mr. Burgess would not consider that he had communicated all his information respecting Constantinople, inasmuch as very little had been said about St. Sophia, and he hoped therefore the Institute might be favoured with another paper on that remarkable building, of which comparatively little was known in this country. The drawings of the Mahomedan buildings at Bejapoor, now exhibited by Colonel Sykes, were proofs of the skill of the Mahomedans as architects.* The style which they adopted was peculiar, and no doubt scientific. The same sentiment and mode of construction might be traced in Turkey, throughout the whole of India, and in the Alhambra.

Mr. Donaldson, Hon. Sec. For. Cor., observed, that the mosque of St. Sophia was the work of Greek and not Mahomedan architects, It would be interesting to know the history of the other mosques at Constantinople, and whether they also owed their origin to Greek architects. Their simi-

* In reference to these drawings Mr. Donaldson observed, that they were especially interesting, from the elaborate and careful manner in which they had been prepared, and as illustrations of the employment of colour and mosaics.

Colonel Sykes, Visitor, stated that the drawings referred to were due to the suggestion of a member of the Institute, Mr. Fergusson, who strongly urged the importance of having plans and sections of these buildings, especially of the great dome of the Gol Goomuz, the diameter of the lower octagon of which was no less than 135 feet. Orders were accordingly sent out to the government of Bombay, and, under the superintendence of Mr. Frere, the distinguished Commissioner of Scinde, who was a great lover of art, the seventy-four plans, elevations, and sections now submitted to the meeting had been prepared; and so accurately had this been done, that it would be quite practicable to reconstruct the buildings from these drawings alone. These buildings were erected by a dynasty (comprising five or six kings), which was put an end to by Aurungzebe, in the seventeenth century, and which had expended vast sums of money, and displayed great taste in architecture, as the Mahomedans always did. The beauty and harmony of the colouring in these works, was especially characteristic and remarkable. In reply to Mr. Tite, Colonel Sykes added, that the buildings in question were constructed of brick and slate, the latter admitting of a durable polish. The surrounding country was flat, and whatever stone was used, had to be brought from a considerable distance. Hitherto it had been presumed that no marble adapted for building or statuary was to be met with in India, but from intelligence received by the last mail, it appeared that through the energy and zeal of the gentleman in charge of the museum of mineralogy at Madras, some very fine marble had been discovered in many districts. Colonel Sykes briefly described the composition of the chunam (so called) or stucco forming the surface of the walls.

larity of plan rather favoured this idea; but it was a question well deserving study, how far the Turks had departed from that type and added new features to it. Signor Fossati, who had been employed to restore the mosque of St. Sophia, had published an instructive illustrative work on that building. And this study would be further facilitated by an important work, now in course of publication at Berlin by Salzenberg, a German architect, who had been sent out on purpose to examine, and take plans and details of the Greek churches of Constantinople.

Mr. Burgess stated, that he had never been inside the mosque of St. Sophia, to which admission was not obtained without much greater difficulty than in the case of other mosques. He believed that all the Turkish mosques were built upon the plan of St. Sophia. He had visited one at Adrianople, which corresponded exactly with that of Solimanea, which he had described.

Mr. Alfred Bailey, Associate, said that, having been very recently in Constantinople, he was able to state that the bigotry against Christians, which formerly existed, was very much diminished. He had himself been in at least three dozen mosques, and never found any difficulty in obtaining the necessary firman, with the aid of a few piastres. In the autumn of 1852, when he was at Constantinople, a fire took place adjoining the Hippodrome, which exposed to view an immense circular wall, which had been taken for a theatre, but which at all events proved that the Hippodrome had formerly occupied a much larger space than at present. He might observe that one of the heads of the serpents forming the twisted column of bronze (referred to by Mr. Burgess), was preserved in the Museum of the Armoury, and that in one of the outbuildings of the church of St. George a museum had been formed, in which a number of sarcophagi and other objects of antiquity were preserved; although from their religious creed, which regarded as an abomination all representations of the living form, an immense number of monuments had been destroyed by the Turks. It was to be regretted that the church of St. Sophia, like other Byzantine works, had been disfigured, first by a coat of compo, and then by a coat of yellow wash. Upon the whole there could not be a doubt that the architects of Constantinople, who had produced such magnificent mosques, fountains, &c., were decidedly great artists, and had left some equivalent for the older works which they had destroyed.

Mr. Papworth, Fellow, suggested that it appeared from the best authorities, that the Mahomedan princes and nobles, not only in former times but to this day, employed Armenian christians as the architects and builders of their mosques and temples; and that this might have been the case in Constantinople, in Egypt, in Syria, and even in the north of India, on the confines of Persia.

Colonel Sykes said that this was not the fact in India.

The thanks of the meeting were unanimously voted to the Rev. Mr. Burgess, and the proceedings of the Session terminated.

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Incorporated in the Seventh Year of William IV.

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THE REPORT OF THE COUNCIL,

READ AT THE ANNUAL GENERAL MEETING HELD 2ND MAY, 1853;

WITH

THE BALANCE SHEET,

AND

LIST OF CONTRIBUTIONS TO THE COLLECTION AND LIBRARY.

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REPORT OF THE COUNCIL

TO THE ANNUAL GENERAL MEETING, MAY 2ND, 1853.

A REVIEW of the proceedings during the past twelve months gives assurance to the Council that satisfactory advancement in its prospects and objects still continues to mark the career of the Royal Institute of British Architects.

Since the last Annual Meeting the Institute has received the accession of one Fellow, previously an Associate, ten Associates, two Honorary Members, and Five Honorary and Corresponding Members; while one Fellow and Four Associates have retired, and the names of Messrs. J. Green and W. A. Nicholson, Fellows, of Huvé, Japelli, Ittar and Haviland, Honorary and Corresponding Members, and of C. J. Eddrup, Associate, have been lost to the list of Members through the decease of those gentlemen.*

The Council venture to suggest to several Associates, who have now been several years Members of that class, and are occupying leading positions in their profession, the propriety of becoming full Members; while the Council look confidently forward to an accession to both classes, when the reduced subscription now paid by Country Members shall have become more generally known by those qualified to join the Society, who may appreciate the advantages offered by it.

The presentation of the Royal Gold Medal for the year 1851, which was awarded to the Chevalier Leo von Klenze, of Munich, took place at an Ordinary General Meeting in June last, when the Bavarian Minister, Baron Cetto, who was present to receive it from our President, returned thanks on behalf of that distinguished architect.

* The Institute now consists of 120 Fellows, 19 Honorary Fellows, 17 Honorary Members, 86 Honorary and Corresponding Members, and 107 Associates.

The recommendations of the Council with respect to the award of the Royal Gold Medal, and the other Medals and Prizes of the Institute, for the year 1852, were taken into consideration and approved, at a Meeting specially summoned for the purpose. The Royal sanction having been obtained, the presentation took place at the following Meeting, when our President, Earl de Grey, presented the Royal Medal to Sir Robert Smirke, Honorary Fellow, R.A., who was represented on the occasion by his brother, Mr. Sydney Smirke, Fellow, A.R.A. The eulogistic terms in which the presentation was made by the Noble Earl, and Mr. S. Smirke's acknowledgment in reply, have been faithfully recorded in the printed report of that Meeting.

The enlarged scope given last year to competitors for the Silver Medals of the Institute appears to have been so far productive of the desired result, that two Silver Medals of the Institute, and two Silver Medals of Merit, have been this year awarded.

For the current year the choice of subjects for the Essays is left almost unlimited to the competitors, provided they adhere to such as are strictly connected with Architecture. The Council must express their desire that this freedom of choice may stimulate numerous candidates to enter the field of competition.

The most important of their proceedings, connected with the internal regulations of the Institute, during the last twelvemonth, which the Council have to mention, is the revision of the Bye-Laws, to which they devoted much time and attention, availing themselves of the able advice and assistance of the Honorary Solicitor, to whom they feel that the Institute is much indebted for this and numerous other kind offices most promptly rendered. At his suggestion several amendments, tending to simplify the Bye-Laws, were made, which, with the reduction in the payments by Country Members, and the regulation for making known the names of all Members in arrear on the first Monday in May of each year, constitute the chief alterations, which were ratified at a Meeting specially called to consider them in January last, and copies of the new Bye-Laws were subsequently forwarded to all the Members.

Shortly after the last Annual Meeting our Noble President opened his mansion for the reception of the Members of the Institute, numerous Artists, and Literary and Scientific individuals.

His Lordship, to whose ever ready advice and co-operation the sincere thanks of the Council are justly due, has consented to be again placed in nomination for the office of President, which he has so well filled since the formation of the Society.

The subscription, raised among the Members of the Institute, in aid of the researches at Nineveh, has been forwarded to Colonel Rawlinson, who had undertaken to apply the funds in the manner desired, and has since expressed his intention of placing any results of the excavations at the disposal of the Institute.

The Council have every reason to believe that the Memorial, on the condition of the Royal Tombs in Westminster Abbey, which was submitted last year by the Institute to Her Majesty, is again under consideration.

At the Ordinary General Meetings which have taken place during the last twelvemonths, papers and discussions on various interesting subjects have been brought before the Members present, while the same endeavours as heretofore have been made to convey a correct account of the proceedings to those who were absent.

Mr. Hesketh, Fellow, explained his method of admitting daylight into buildings, especially in the narrow and confined localities of towns; and exhibited his Patent Combination Reflectors, by means of which he has produced satisfactory results, in very difficult situations. On the same occasion, a very interesting letter was read from Mr. Tite, Fellow, describing the excavations and discoveries which had been made by the Commendatore Canina, Honorary and Corresponding Member, on the Appian Way, in the neighbourhood of Rome. Mr. Penrose, Fellow, gave an instructive account of the difficulties which the Architect of St. Paul's Cathedral had to contend with in designing and executing that building, and followed up the subject on another evening by some remarks on the decorations suitable and required to complete the interior in accordance with the supposed intentions of Sir Christopher Wren. The honourable and responsible situation which Mr. Penrose has subsequently been elected to fill in connexion with the Cathedral, and the repairs to the paintings of the cupola which have been commenced, are proofs of the assurance which the authorities feel, that the same talent which enabled him to elucidate the minute refinements of Grecian Architecture, will also be available to ensure the due completion of our Metropolitan Cathedral.

Mr. Charles Winston, who has since been elected Honorary Member, gave two instructive papers on the revived manufacture of coloured glass used in ancient windows, and on the methods of painting upon glass. The value of his researches, and his perfect acquaintance with the subject, have received full confirmation in the specimens of glass painting which have been erected at his expense in the round part of the Temple Church. A memoir of Mr. Savage was read at one of these meetings. As the Architect of St. Luke's Church, Chelsea, his name was familiar to the public and to the profession, while the fact was not so well known, that he was one of the few remaining who had, till a late period, practised his profession in its entirety, not recognizing the distinction between the architect and the engineer, which of late years has taken place in its ranks.

Some information, conveyed in a letter from Mr. Tite, then in Rome, induced our esteemed Honorary Member, the Rev. Richard Burgess, to explain his present views on the topography of the Roman Forum and the Clivus Capitolinus, with the nomenclature of the Temples thereon. The much debated subject of site and of nomenclature, seemed to be fairly stated and set at rest by his observations and critical acumen in reconciling the passages of ancient writers with the results of modern discoveries, while the interest of the subject was much enhanced by the large photographic drawings of the Forum in its present state, which Mr. Tite had procured in Rome, and which he exhibited on the occasion.

Our noble President favoured the meeting with an account of the proceedings at Fountains Abbey, from which it was evident that great care, guided by refined taste and judgment, is bestowed by his Lordship in arresting the progress of decay, and preserving the integrity of the original fragments of this interesting relic of a by-gone age.

Two evenings at the commencement of the present session were given to the consideration of the sites proposed for the National Gallery, Mr. C. H. Smith offering some suggestions for altering and enlarging the present edifice, by occupying the site of certain buildings now standing on the north east of it. A learned investigator from Hungary, Dr. Henzlemann, having expressed a great desire to call the attention of the Institute to his theory respecting the constructional laws followed by the Mediæval Church Architects, an opportunity was afforded him for explaining an elaborate series of drawings which he had prepared in illustration of the subject; and a Committee, which was subsequently appointed at his request to examine the merits of his alleged discovery of those laws, devoted much time and pains to the investigation, and

highly commended the zeal, learning, and industry, which Dr. Henzlemann had bestowed on the prosecution of his researches.

Mr. G. R. Burnell, C.E., laid the result of his observations, made during an excursion in the province of Orense, in the Kingdom of Galicia, before a Meeting in December, and showed the value to which due energy and perseverance might turn the natural advantages of that neglected country. Mr. Donaldson, V.P., afforded the benefit of his remarks on a highly curious and interesting class of Gallo-Byzantine Churches in and near Perigueux, in France, to which scientific attention had been called by our Fellow, Mr. E. Sharpe, previously to their attracting the notice of French Architects and Archæologists. At the following Meeting, Mr. Donaldson gave the results of much research and investigation in a paper on the Architectural Medals of the Ancients, as illustrating the edifices of the Greeks and Romans. The labour involved in preparing the numerous illustrations which accompanied this lecture, appeared almost too valid a reason for hesitating to request an immediate continuation of the subject, though desired by the Members, and kindly promised by him.

A communication from Mr. Hay, entitled an attempt to develop the principle which governs the proportions and curves of the Parthenon, of Athens, with a few observations on the application of Æsthetic Science to Architecture generally, being a subject which required much consideration, Mr. Hay kindly consented to allow his diagrams to remain in the rooms of the Institute for inspection till required for publication, for which purpose they have since been returned to him. We may, therefore, look forward to the benefit of a work especially devoted to Architecture, in addition to those on kindred subjects which he has already sent forth. Mr. H. Twining, whose devotion to the Fine Arts is well known, explained the use of an ingenious instrument, invented by himself, called the Artist's Goniameter, by means of which that accuracy of delineation from real objects, which is so essential to the Architect, can be insured.

Signor G. Abbate, of Naples, gave us, in his native language, the result of many years' intense devotion to the study of the decorative painting of Pompeii, which Mr. M. Digby Wyatt, Associate, explained and enlarged on in a highly interesting manner. The Members availed themselves of the occasion to express their sense of the spirited conduct evinced by the Directors of the Crystal Palace Company in securing the assistance of Signor Abbate to produce a fac-simile of a Pompeian dwelling at Sydenham, and in obtaining, for public inspection and information, casts of the most celebrated productions of sculpture, both in this country and abroad.

At the last Evening Meeting, Mr. T. H. Lewis, Fellow, explained the details and construction of the building called the Royal Panopticon of Science, in Leicester Square, in the construction and decoration of which he has given evidences of great skill and feeling, combined with sedulous attention to the numerous and complicated arrangements essential to the success of such an establishment.

The introduction of an improved Bill for the regulation of Metropolitan Buildings, has not hitherto taken place in the House of Commons, but it is understood that the First Commissioner of Her Majesty's Works and Public Buildings will during the recess take into consideration a measure for that purpose, in which it may be hoped that the recommendations conveyed by the Institute to a former head of that department will not be altogether overlooked.

It is satisfactory to be assured that comprehensive measures are being taken by the different Companies, under the sanction of the Government, to ensure an ample supply of water to this Metropolis, and that the grand question of conveying away the sewerage without polluting the river, is undergoing such investigation as may be expected to lead to important results; while the determination evinced by the constituted authorities to enforce the closing of intramural grave-yards, the erection of fit dwellings for the labouring classes, the formation of public parks, and, not least, the intention expressed of erecting numerous additional churches, are satisfactory proofs of progress in a right direction: nor should it be forgotten in this Institute, that the attention now given to improving the dwellings of the poor has received great impetus from the philanthropic endeavours and suggestions of our Fellows, Mr. Roberts and Mr. Godwin;—the latter, by his recent investigation of the wretched habitations existing in the centre of this Metropolis; —the former, by his earlier researches among the same scenes, and by his long continued course of usefulness as Honorary Architect to the Society for improving the dwellings of the Labouring Classes.

It appears that a Committee of the House of Commons will be appointed to consider the subject of bridge accommodation for the Metropolis generally; while among those as yet contemplated or in progress, mention may be made of the new bridge proposed at Westminster, of one in the vicinity of Charing Cross, of another near St. Paul's, besides the suspension bridge now in course of

erection at Battersea. Among other improvements, reference may be made to the continuation of the street from Cannon Street to the south side of St. Paul's, by which that building will be presented in a novel and highly effective point of view; to the progress made in Victoria Street, Westminster, and to the new Cattle Market, in Copenhagen Fields, in lieu of that which has for centuries been held in the very centre of the City; nor should mention be omitted of the buildings designed with apparently somewhat similar views, viz., the Crystal Palace at Sydenham; and the Panopticon of Science, in Leicester Square. The introduction of sculptural decoration into the Mansion House, at the suggestion of our Fellow, Mr. Bunning, is a highly gratifying proof of the existence of an increased feeling for Fine Art in this Metropolis. The buildings erected for the Industrial Exhibition in Dublin, and the proposed restoration of the Church at Doncaster, recently destroyed by fire, may perhaps be mentioned as the most remarkable architectural matters occurring at a distance from the Metropolis.

The Council cannot refrain from alluding with great satisfaction to that portion of the Report of the Royal Commissioners, which recommends the application of the surplus funds of the Great International Exhibition of 1851 to founding an Institution which may serve to increase the means of industrial education, and extend the influence of science and art upon productive industry. Nor can they omit to call attention to the opportunities for study which will be offered by the noble collection of casts from the best sculptures at home and abroad, now in course of formation in the Crystal Palace at Sydenham, and to the progress which has already been made in the department of Practical Art at Marlborough House, where the sound principles of design and decoration urged by our Members, Owen Jones and Digby Wyatt, are appreciated, and from which an important document has just emanated in the shape of the first Report. The advantages offered by the Museum of Economic Geology must be too obvious to call for any lengthened eulogium in a Society of practical Architects.

An invitation which M. de Caumont conveyed to the Members, through our Honorary Secretary for Foreign Correspondence, to be present at an Archæological Congress at Paris, offered an opportunity to some of them to inspect the vast architectural improvements which have taken place, as well as those which are in progress in that metropolis.

During the past year some important additions have been made to our Library and Collection. His Majesty the King of Prussia was pleased to honour the Institute, by presenting, through his Ambassador, the Chevalier Bunsen, a Copy of an important work on Egypt, the result of the investigations of the Commission which his Majesty had sent to that country, under the direction of Dr. Lepsius. The Commendatore Canina has forwarded the concluding portion of his learned work Etruria Marittima compresa nella dizione Ponteficia. Signor Fossati has forwarded his Illustrations of the Mosque Aya Sofia at Constantinople, which has recently been restored under his superintendance. M. Hector Horeau has given his Panorama of Egypt; and M.M. César Daly, of Paris, and Förster, of Vienna, have continued to supply us with the well-known serial works published by them. Among the donors to the Collection, we have to thank Mr. Catherwood for a large specimen of auriferous quartz, from California, Mr. Brandon for a slab of Parian marble, Mr. Falkener for numerous interesting specimens of building materials, from Greece, Asia Minor and Egypt; and Mr. Twining for the instrument called the artist's Goniameter, invented by him. The names of other donors to the Library and Collection are set forth in the list attached to the Report; but among them the Council cannot omit to mention that of the Rev. J. L. Petit, Honorary Member, the author of many well-known works on Mediæval Ecclesiastical Architecture.* The Council have just adopted the recommendation of the Library Committee, respecting the purchase of several works required to complete defective sets, and of others which they consider essential to the practical utility of the Collection.

Impressed with the advantage which the Library would derive from containing the Parliamentary Reports and Blue Books, connected with professional subjects, issued during the Session of the two Houses of Legislature, the Council have applied to their President and to Mr. J. Bell (Fellow), M.P., to assist them in obtaining those documents; and they trust that the Parliamentary regulation, stated to be in contemplation, for forwarding such papers to certain literary and scientific institutions, will soon be carried into effect to the advantage of this Institute.

Anxious to obviate complaints respecting the present accommodation, the Council have repeatedly sought for rooms more advantageously situated, and

* During the past year, 112 volumes of books and pamphlets, 25 engravings and prints, and 81 miscellaneous articles, have been added to the Library and Collection.

they have to report that several propositions are now occupying the attention of the Committee specially appointed to enquire for new premises. The Council will be most happy to submit to the Members any feasible proposition that may be offered, by which better accommodation in a more convenient position may be obtained; at the same time they invite the co-operation of all interested in their endeavour to carry out the often expressed wishes of the Members.

The Balance Sheet for the year ending December 31st, 1852, signed by the Auditors, is now submitted, with a supplementary statement to the present date. The balance in hand this day is less than that of last year by the sum of £42. 4s. 4d., but £177. 18s. 6d. Stock, which includes the life subscriptions of certain Members, has been purchased and added to the Funded Stock of the Institute.

Many Members having adopted the recommendation contained in the Report of last year, and given the order for payment of their annual subscriptions by their Bankers in the form proposed, a copy of it is appended to the present Report.

The punctual and assiduous attention given by the Librarian to the numerous and various duties undertaken by him, continues to entitle him to the cordial acknowledgment of the Council.

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*Messrs.*_____

Please to pay Messrs. Herries, Farquhar, & Co. *my Subscription of* *to the* Royal Institute of British Architects, *due on the* 1*st of January*, 18 *;—and the same amount on the* 1*st of January in every succeeding year, till further notice.*

London, 18

General Account of the Receipts and Disbursements from December 31st, 1851, to December 31st, 1852.

RECEIPTS.

1852.				£	s.	d.
To Balance in the hands of the Treasurer, Dec. 31, 1851..			267	7	10	
— Ditto in the hands of the Librarian, Dec. 31, 1851....			7	2	1	
						274 9 11
— Composition of one Fellow (in lieu of Annual Subscription)		....				36 15 0
— Admission Fees of four Fellows	at £5. 5s.		21	0	0	
— Subscriptions of seventy-seven Fellows for the year 1852.....	at £4. 4s.		323	8	0	
— Ditto of eleven Fellows ditto.....	at £3. 3s.		34	13	0	
— Part of Arrears of Subscriptions of Fellows for previous years			40	19	0	
— Admission Fees of five Associates	at £1. 1s.		5	5	0	
— Subscriptions of eighty-eight Associates for the year 1852	at £2. 2s.		184	16	0	
— Ditto of two Associates ditto.....	at £1. 1s.		2	2	0	
— Part of Arrears of Subscriptions of Associates for previous years			18	18	0	
— Subscription of one Associate for the year 1853	at £2. 2s.		2	2	0	
— Admission Fees of two Students	at £1. 1s.		2	2	0	
— Subscriptions of five Students for the year 1852	at £1. 1s.		5	5	0	
			640	10	0	
— *Dividends on Stock : viz.*—						
Half Year's Dividend on £1444. 0s. 11d., £3 per Cent. Consols (less Income Tax).....			21	0	7	
Half Year's Dividend on £1508. 17s. 4d., £3 per Cent. Consols (less Income Tax)			21	19	5	
One Year's Dividend on £123. 1s. 7d., £3 per Cent. Reduced Annuities (less Income Tax)			3	13	10	
— Amount received of Mr. Weale for sale of Dilapidations Report			3	10	11	
— Amount received for nine Ivory Admission Tickets ..			0	9	0	
						691 3 9
						£1002 8 8

EXPENDITURE.

1852.	£	s.	d.
By Rent for One Year to Christmas, 1852	200	0	0
— Taxes, and Insurance of the Books, Collection, &c.....	11	7	8
— Fuel and Light.....	18	16	6
— Attendance	47	18	0
— Librarian's Salary.....	105	0	0
— Printing, Lithography, &c. and Reporter	132	8	6
— Stationery, Postage, and Delivery of Letters, Advertisements, &c.....	61	14	2
— Purchase of Books, &c., Bookbinding, Freight and Duty on Foreign Books	22	10	1
— Prize Medals and Prize Books	6	10	0
— Furniture, Fittings, and Occasional Repairs.....	8	8	6½
— Tea, Coffee, &c. at Evening Meetings (including extra Attendance).....	28	3	5
— Ivory Admission Tickets.....	0	11	0
— Petty Disbursements	1	11	9
	644	19	7½
— Purchase of Stock, viz.—£64. 16s. 5d., £3. per Cent. Consols.	63	0	0
— Ditto viz.— 141. 2s. 8d., £3. per Cent. Consols.	143	1	4
— Balance in the hands of the Treasurer, Dec. 31st, 1852..... 136 13 9			
— Ditto in the hands of the Librarian, Dec. 31st, 1852..... 3 3 11½			
— Ditto ditto for Attendant's Salary, one Quarter in advance. 11 10 0			
	151	7	8½
	£1002	8	8

ASSETS.

			£.	s.	d.
Cash in the hands of the Treasurer and of the Librarian on Dec. 31st, 1852.....			151	7	8½
Amounts due from Members: viz.—					
Fellows for the year ending 31st December, 1851...	33 12 0				
Associates ditto 1851...	13 13 0				
		47 5 0			
Fellows for the year ending 31st December, 1852...	45 3 0				
Associates ditto 1852...	27 6 0				
		72 9 0			
Total Subscriptions owing to December 31, 1852.....			£119	14	0

LIABILITIES.

None but Rent, Salaries, and other current Expenses, from December 25th, 1852.

PROPERTY.

The Value of Copies of Transactions, and Reports on Competitions, on hand.

Books, Drawings, Prints, Models, Casts, Furniture, &c.

THE FUNDED STOCK of the Institute consists of:—

£1650. 0s. 0d. £3. per Cent. Consols,

£123. 1s. 7d. £3. per Cent. Reduced Annuities. (Travelling Fund).

J. J. SCOLES, *Hon. Sec.*

J. H. GOOD, Jun., *Fellow,*
J. FERGUSSON, *Associate,* } *Auditors.*

Supplementary Balance Sheet to May 2nd, 1853.

RECEIPTS.

	£.	s.	d.
To Balance in the hands of the Treasurer and Librarian, Dec. 31st, 1852	151	7	8½
— Subscriptions and Entrance Fees, Composition, Donations, &c., received from December 31st, 1852, to May 2nd, 1853	640	10	0
— Dividend on £1650. 0*s.* 0*d.*, £3. per Cent. Consols 24 0 7			
— Ditto 123. 1*s.* 7*d.*, £3. per Cent. Reduced Annuities 1 16 11			
	25	17	6
	817	15	2½

EXPENDITURE.

	£.	s.	d.
By Rent, Taxes, Salaries, and other current Expenses, from December 25th, 1852, to May 2nd, 1853	208	16	7
— Purchase of Stock, £36. 15*s.* 10*d.*, £3. per Cent. Consols	36	15	0
— Balance in the hands of Treasurer and Librarian	572	3	7½
	817	15	2½

ASSETS.

	£.	s.	d.
Cash in the hands of the Treasurer and of the Librarian	572	3	7½
Amount due from Members to May 2nd, 1853	153	6	0

LIABILITIES.

None but Rent, Salaries, and other current Expenses, from March 25th, 1853.

PROPERTY.

The Value of Copies of Transactions, and Reports on Competitions, on hand.

Books, Drawings, Prints, Models, Casts, Furniture, &c.

THE FUNDED STOCK of the Institute consists of:—

£1686. 15*s.* 10*d.* £3. per Cent. Consols.

123. 1*s.* 7*d.* £3. per Cent. Reduced Annuities. (Travelling Fund).

CONTRIBUTIONS

TO

THE COLLECTION AND THE LIBRARY OF THE INSTITUTE,

Between the 3rd of May, 1852, and the 2nd of May, 1853.

The Rev. J. L. Petit, Honorary Member. A donation of Twenty Guineas to the Library Fund.

W. A. Mason, Associate. A donation of Two Guineas to the Library Fund.

ENGRAVINGS AND LITHOGRAPHIC PRINTS.

J. B. Bunning, Fellow. Billingsgate Market, 1851. J. B. Bunning, Architect. Coloured Lithographic View.

Messrs Davy and Sons. Illustrated Particulars with Plans of the Milton Abbas Estate, Dorsetshire, (containing seven Lithographic Views of Milton Abbey.) folio. London, 1852.

Sir Edward C. Dering, Bart. Plan for Building on the Henwood Estate, the property of Sir Edward C. Dering, Bart., Ashford, Kent. George Godwin, F.R.S., Architect. Lithograph.

T. L. Donaldson, V.P. Portrait of Julius H. Mansart, engraved by E. Edelinck, from a Painting by H. Rigaud. 1647-1708. Portrait of George Gutch, Fellow, from a daguerreotype by J. W. G. Gutch. Lithograph.

The Directors of the Hope Mutual Life Assurance and Honesty Guarantee Society. Almanac for the Year 1853. Colored Lithograph.

J. J. Hittorff, Honorary and Corresponding Member. Tracings of the Plan, Elevation, Section and Details, of the Cirque Napoleon at Paris.

Messrs. Maughan and Fowler, Architects, Louth. Elevation of West Side, and Vertical Section looking East, of the Tower of the Church of St. James, Louth, Lincolnshire. Lithograph. 1852.

A. Morant, Esq. Print of Sir C. Wren, engraved for Elmes's Life of Wren. London, 1823.

J. W. Papworth, Fellow. Portrait of Benjamin Wyatt, Esq. Engraved by T. Blood for the European Magazine, from an Original Painting by S. Drummond, A.R.A. London, 1812.

Alfred Smith, Fellow. Three Interior Views of the Army and Navy Club House—The Morning Room, Coffee Room. and Staircase. Drawn and Lithographed in Colours, by R. K. Thomas, under the direction of Alfred Smith, Esq., Architect.

J. F. Wadmore, Associate. A Coloured Lithograph of a New Stained Glass Window, recently put up in the Worshipful Company of Skinners' Hall, under the superintendence of Mr. George Moore of Lincoln's Inn Fields, Surveyor to the Company.

Messrs. Weightman, Hadfield, and Goldie. South-west View of St. George's Church, Doncaster. Drawn by J. G. Weightman. Engraved by Robert Sands. London, Jan. 1, 1828.

M. Digby Wyatt, Associate. Roman Tessellated Pavement, discovered on the Grounds of Andrew Lawson, Esq., at Aldborough, Yorkshire, September 22, 1848. Colored Lithograph.

MISCELLANEOUS.

David Brandon, Fellow. A Slab of Parian Marble.

J. B. Bunning, Fellow. A Medal in commemoration of the Opening of the New Coal Exchange, October 30th, 1849.

F. Catherwood, Honorary and Corresponding Member. A Slab of Quartz, of the Gold-bearing kind, from California.

E. Falkener, Associate. A Collection of Specimens of Building Materials from Egypt, Greece, and Italy, consisting of about seventy pieces.

R. Hesketh, Fellow. Specimens of Glass coated with Metallic Silver, as used for Hesketh's Patent Combination Reflectors. Three pieces.

R. C. Hussey, Fellow. A medal struck in commemoration of the Restoration of the Church at Frittenden, Kent, 1848.

J. Jennings, Fellow. An Improved Valve for Closet Cisterns and a new Bell Trap, invented by Mr. George Jennings.

Henry Twining, Esq. An Instrument called the Artist's Goniameter.

James Yates, Esq. A Medal representing Birmingham Town Hall, inscription "First Musical Festival, Oct. 1834;" and Birmingham Free Grammar School, inscription, "Founded by King Edward VI. 1552. Present Edifice finished 1837." A Medal of Birmingham Free Grammar School. Founded 1552, rebuilt 1707. Present Edifice erected 1836. C. Barry, Architect.

BOOKS, PAMPHLETS, &c.

His Majesty the King of Prussia. Denkmaeler aus Aegypten und Aethiopien nach den Zeichnungen der von Seiner Majestaet dem Koenige von Preussen Friedrich Wilhelm IV. nach diesen laendern gesendeten und in den Jahren 1842-1845, ausgefuehrten wissenschaftlichen Expedition auf Befehl Seiner Majestaet herausgegeben und erlaeutert von C. R. Lepsius, 5 vols. plates, large folio, Berlin, vols. 1 and 2 incomplete.—Vorläufige Nachricht über die Expedition, ihre Ergebnisse und deren Publikation. 4to., Berlin, 1849.

The Architectural, Archæological, and Historic Society, for the County, City, and Neighbourhood of Chester. Journal. Part 2, from July 1850 to December 1851. 8vo. Chester, 1852.

The Society of Antiquaries. Archæologia: or Miscellaneous Tracts relating to Antiquity. Published by the Society of Antiquaries of London. vol 33 in two parts, 4to. London, 1849; vol. 34 in two parts, 4to. London, 1851. Proceedings of the Society of Antiquaries of London, vol. 2, Nos. 18 to 32, 8vo. 1849 to 1852. Report of the Committee appointed by the Council of the Society of Antiquaries, to investigate the circumstances attending the recent discovery of a Body in St. Stephen's Chapel, Westminster. Pamphlet, 4to. London, 1852.

The Architectural Institute of Scotland. Proceedings of the Institute. Third Session. 1852-53. 1st to 9th Meetings. 8vo. Edinburgh. Transactions of the Architectural Institute of Scotland. vol. 2, parts 3 to 6. 8vo. Edinburgh, 1852. Illustrations of an Essay on Mural Decoration, read before the Architectural Institute of Scotland. By Thomas Purdie. Engraved for the Transactions of the Institute. folio. Edinburgh.

The Architectural Publication Society. Text with Illustrations. Part 1 of Volume for 1851-52. folio. London, April 5th, 1852. Part 2 of volume for 1851-52. folio. London. September 6, 1852. Part 3 of Volume for 1851-52. folio. London, 21st February, 1853.

The Archæological Institute of Great Britain and Ireland. Map of the Watling Street, the chief line of Roman communication leading across the Counties of Durham and Northumberland, from a Survey made in the years 1850 and 1851, by direction of his Grace the Duke of Northumberland. Surveyed and drawn by Henry Mac Lauchlan. folio. London. Memoir written during a Survey of the Watling Street, from

the Tees to the Scotch Border, in the years 1850 and 1851. By Henry Mac Lauchlan. Pamphlet. 8vo. London, 1852. Proceedings at the Annual Meeting of the Archæological Institute of Great Britain and Ireland. At York, July 1846, 2 Parts. . 8vo. London, 1846.
Ditto At Norwich, July, 1847. . . 8vo. London, 1847.
Ditto At Lincoln, July, 1848. . . 8vo. London, 1848.

The Council of the Art-Union. Sixteenth Annual Report of the Council of the Art-Union of London, with List of Subscribers. 8vo, London, 1852. Art-Union of London Almanac, 1853. Two copies Sheets. Two copies 48mo.

The Bristol Society of Architects. Rules of the Society, established April 3rd, 1850. 12mo. Bristol. First Annual Report for May, 1851. Second Annual Report for May, 1852.

The Chevalier Bunsen. Prussian Minister. Honorary and Corresponding Member. Berliner Gemeinnützige Bau-Gesellschaft, (Prospectus of) Berlin, im Dezember, 1851. A Sheet.

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M. César Daly, Honorary and Corresponding Member. Revue Générale de l' Architecture et des Travaux Publics: Publié sous la direction de M. César Daly. 6^{e} volume, numeros 2 et 3. 1845. 7^{e} volume, numero 4. 1847. 10^{e} volume, numeros 1, 2, 3, et 4. 1852. 4to. Paris.

Sir Henry De La Beche, on the part of Her Majesty's Government. Memoirs of the Geological Survey of Great Britain, and of the Museum of Economic Geology in London, vol. 1, 8vo., London, 1846; vol. 2, parts 1 and 2, 8vo., London, 1848—Museum of Practical Geology and Geological Survey. Records of the School of Mines and of Science applied to the Arts, vol. 1, part 1, 8vo. London, 1852—Report with reference to the Selection of Stone for Building the New Houses of Parliament. folio. London, 1839.

The Devonport Mechanics' Institute. Report of the Committee of the Devonport Mechanics' Institute, for the half-year ending March 25th, 1852. 8vo. Devonport.

T. L. Donaldson, V.P. Exemplars of Tudor Architecture, adapted to Modern Habitations. 4to. London, 1830, Designs for Parsonage Houses, Alms Houses, &c., Architettura Campestre. 4to. London, 1827, and Half a Dozen Hints on Picturesque Domestic Architecture. By T. F. Hunt, Architect. 4to. London, 1825. The Industrial Arts of the Nineteenth Century: a series of Illustrations of the Choicest Specimens produced by every Nation at the Great Exhibition of Works of Industry, 1851. Dedicated, by permission, to His Royal Highness The Prince Albert. By M. Digby Wyatt, Architect. Divisions 1st, 2nd, and 3rd. folio. London, 1851-52.—La Théorie et la Pratique du Jardinage. 4to. Paris, 1709.

G. F. Eckstein, Esq. A Practical Treatise on Chimneys. By G. F. Eckstein. 8vo., London, 1852.

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The Editor. The Literary Gazette, Nos. 1824 to 1893. 4to., London.

The Editor. The Canadian Journal. A Repertory of Industry, Science and Art; and a Record of the Proceedings of the Canadian Institute, vol. 1, Nos. 1 to 7. 4to., Toronto, 1852-53.

The Editor. Gazette des Beaux-Arts, 1er volume, Nos. 1 to 5, 4to. Paris, 1853.

Exeter Diocesan Architectural Society. Transactions of the Exeter Diocesan Architectural Society, vol. 4, part 2, 4to., Exeter, 1852.

C. F. Ludwig Förster, Honorary and Corresponding Member. Allgemeine Bauzeitung mit Abbildungen. Redigirt und herausgegeben von Prof. C. F. L. Förster, Architekt. Plates folio, 2 bis 12 Heft, 4to. Vienna, 1852.

The Chevalier Gaspard Fossati, Honorary and Corresponding Member. Aya Sofia Constantinople, as recently restored by order of H. M. the

Sultan Abdul Medjid, from the original drawings by Chevalier Gaspard Fossati. Lithographed by Louis Haghe, Esq. folio, London, 1852.

Henry Garling, Fellow. Recueil de différents Projets d'Architecture de Charpente et autres concernant la Construction des Ponts. Par Feu M. Pitrou. folio, Paris, 1756.

George Godwin, Fellow. History in Ruins: a Series of Letters to a Lady, embodying a Popular Sketch of the History of Architecture. By George Godwin, F.R.S. Small 8vo., London, 1853.

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W. P. Griffith, Fellow. Architectural Botany; setting forth the Geometrical Distribution of Foliage, Flowers, Fruit, &c. (extracted from Ancient Gothic Churches, part 3). By William Pettit Griffith, Architect. 4to. London, 1852. Ancient Gothic Churches, their Proportions and Chromatics. Part the Third. By William Pettit Griffith, Architect. 4to. London, 1852.

Her Majesty's Commissioners. Second Report of the Commissioners for the Exhibition of 1851, to the Right Hon. Spencer Horatio Walpole, &c.. one of Her Majesty's Principal Secretaries of State. 8vo. London, 1852. Exhibition of the Works of Industry of all Nations, 1851. Reports by the Juries on the Subjects in the thirty Classes into which the Exhibition was divided. Presentation Copy. 8vo. London, 1852.

M. Hector Horeau. Institute de France—Académie des Sciences. Extrait des Comptes rendus des Séances de l'Académie des Sciences, tome xxxiv. —Rapport sur les nouveaux Appareils de Panification de M. Rolland, Boulanger. Pamphlet, 8vo. Paris. Panorama d'Egypte et du Nubie, avec un portrait de Méhémet-Ali et un texte orné de vignettes, par Hector Horeau, Architecte. folio. Paris, 1841.

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W. S. Inman, V.P. The Elements and Mathematical Principles of the Greek Architects and Artists. By John Pennethorne, Pamphlet, 8vo. Lond. 1844.

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The Liverpool Architectural and Archæological Society. Annual Report from the Council. May, 1852. 4to. sheet. Proceedings of the Society, vol. 1, Sessions 1848-49 and 1849-50. 4to. Liverpool, 1852.

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Alfred Morant, Esq. Historischer Schauplatz in welchem die Merkwürdigsten Brücken aus allen vier Theilen der Welt; vorgestellet und beschrieben werden; von Carl Christian Schramm, folio, Leipzig, 1735—Anleitung zur Bürgerlichen Bau-Kunst, von Johann Friedrich Penther, 4 vols. folio, Augsburg, 1744, 1745, 1746 and 1748.

J. Morris, Fellow. Principaux Monuments Gothiques de l'Europe, dessinés sur les Lieux et Lithographiés, par Gustave Simonau. Large folio. Bruxelles, 1843.

C. C. Nelson, Honorary Secretary. The Penny Cyclopædia of the Society for the diffusion of Useful Knowledge, volumes 23, 24, 25, 26 and 27, London, 1842-43. Supplement to ditto, vols. 1 and 2, London, 1846 & 1851

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The Royal Institution of Great Britain. A List of the Members, Officers, &c., with the Report of the Visitors for the year 1851. 8vo. London, 1852. Proceedings of the Royal Institution, Nos. 10, 11, 12, and 14. 8vo. London, 1852.

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W. H. Villiers Sankey, Esq., C.E. Encyclopædia of Engineering, Civil and Mechanical. By Edward Lomax, Esq., C.E., assisted by Thomas Gunyon, Esq., Architect, and C.E., and W. H. Villiers Sankey, Esq., C.E. Division 2. 4to. London.

Signor D. Sauli. Dei Bacini di Carenaggio e particolarmente di quello costrutto nel Porto di Genova dal 1847 al 1851. Memoria di Damiano Sauli. 8vo. Genova, 1852. Plates to ditto.—Dichiarazione di una Riserva fatta da uno de' Membri della Commissione pel Progetto del Doc nel rapporto del 19 Febbraio, 1852. 4to. Genova, 1852.

J. P. Seddon, Associate. Progress in Art and Architecture, with Precedents for Ornament. By John P. Seddon, Architect, M.R.I.B.A. 4to. London, 1852.

Granville Sharpe, Esq. The Prize Essay on the Application of Recent Inventions collected at the Great Exhibition of 1851, to the Purposes of Practical Banking. By Granville Sharpe. (2 copies.) Pamphlet, 8vo. London, 1852.

Edward Snell, Esq. On the Stability of Arches. By George Snell, Assoc. Inst. C.E.. And an Account of the Pont-y-tu-prydd over the River Tâfe, Glamorganshire. By Thomas Macdougall Smith, M. Inst. C.E. 8vo. London, 1846.

The "Société Libre des Beaux Arts." Revue des Beaux Arts, &c. Livraison 9 to 11, and 13 to 24, 1852. Livraison 1 to 4 and 6, 1853.

The Society of Arts. The Journal of the Society of Arts, Nos. 1 to 23. Large 8vo. London, 1852-53.

J. Spurgin, Esq., M.D. Six Lectures on Materia Medica, and its relations to the Animal Economy. By John Spurgin, M.D., F.C.P.S. 8vo. Lond. 1853

H. Twining, Esq. The Elements of Picturesque Scenery, or Studies of Nature made in travel, with a view to improvement in Landscape Painting. By Henry Twining. 8vo. London, 1853.

Charles Winston, Esq., Honorary Member. On the Painted Glass in New College Chapel and Hall, Oxford. By Charles Winston. (From No. 33 of the Archæological Journal). Pamphlet, 8vo. An Introduction to the Study of Painted Glass. By Charles Winston, Esq. Pamphlet, 8vo. Oxford, 1849.

M. D. Wyatt, Associate. An Attempt to define the Principles which should determine Form in the Decorative Arts. By M. Digby Wyatt, Esq. Pamphlet, 8vo. London, 1852.

PROCEEDINGS AT THE ORDINARY & SPECIAL GENERAL MEETINGS, PAPERS READ, &c.

From the 17*th of May*, 1852, *to the* 18*th of April*, 1853.

17*th May*, 1852.—"On the admission of Daylight into Buildings, particularly in the narrow and confined localities of Towns," by Robert Hesketh, Fellow.

Specimens of his Combination Reflectors, as applied to Buildings, were exhibited by Mr. Hesketh. M. Chappuis exhibited and explained M. Troupeau's Patent Diurnal Reflectors.

Some Carvings in Wood, by Mr. Rogers, representing the Via Crucis, were exhibited.

Mr. Austin, Architect, pointed out the application of his Registered Bricks for British Bond and the formation of Hollow Walls.

31*st May*.—"A few remarks on St. Paul's and its appropriate Decorations," by F. C. Penrose, Fellow.

14*th June*.—"On a Revived Manufacture of Coloured Glass used in Ancient Windows," by Charles Winston, Esq.

28*th June*.—"On the Topography of the Roman Forum and the Clivus Capitolinus," by the Rev. Richard Burgess, B.D., Honorary Member.

The Medals and the Premiums in Books awarded during the Session were presented by the President, as follows:—

To Chevalier Leo von Klenze, of Munich, Hon. and Cor. Member (through Baron de Cetto, Bavarian Minister)	*The Royal Gold Medal of the Institute*
To Mr. James Thomas Knowles, jun., for a Design for Public Baths, Laundry, &c. . . .	*The Medal of Merit.*
To Mr. B. Fletcher, Student, for a Design for a Parsonage House	*A Copy of "An Encyclopædia of Architecture," by Joseph Gwilt.*
To Mr. W. Lightly for his Design for the same subject.	*A Copy of "Histoire de L'Art Monumental," par L. Batissier.*
To Mr. W. Lightly, and Mr. T. C. Tarring, Students, for their series of Sketches from subjects given Monthly by the Council during the year . .	*Each a Copy of "Studies and Examples of the Modern School of English Architecture." The Travellers' Club House, by Charles Barry, Architect.*

Earl De Grey, President, read a Paper descriptive of the recent Excavations now proceeding under his Lordship's directions at Fountains Abbey, and the methods adopted to secure the ruins from further injury and decay.

5*th July*.—The adjourned Discussion on the Decorations suitable to St. Paul's, took place at the Closing General Meeting of the Session.

15*th November*.—"Suggestions for altering and enlarging the present National Gallery," by Mr. C. H. Smith.

29*th November*.—A Discussion "On the Sites proposed for the National Gallery," took place.

A portfolio, containing numerous Photographic Drawings of a large size, was exhibited by M. Baillière.

The Chairman announced the decease of John Green, Fellow, and of Signori Ittar and Japelli, Honorary and Corresponding Members.

6*th December*.—At an intermediate Ordinary General Meeting, Dr. Henszlmann explained his series of Drawings illustrative of his alleged discovery of the constructional Laws of Mediæval Church Architecture.

It was Resolved:—That it be referred to the Council to appoint a Committee of three members of the Institute to examine Dr. Henszlmann's communication of his system, and report their opinion thereon to the Institute.

13*th December*.—"Notes on an Excursion in the South West of Galicia," by Geo. R. Burnell, Esq., C.E.

The Chairman announced the decease of Mons. O. Huvé, Honorary and Corresponding Member.

10*th January*, 1853.—"Some remarks on a certain class of Gallo-Byzantine Churches in and near Perigueux in France," by T. L. Donaldson, V.P.

17*th January*.—At a Special General Meeting, it was resolved, that new Bye Laws in the words and form stated and set forth in the printed Paper accompanying the Notice convening the Meeting, entitled, "Bye Laws of the Institute of British Architects," should be, with the verbal alteration made in the same respecting the composition of Country Members removing to London, the Bye Laws of the Institute in the place of the existing Bye Laws, and that all then existing Bye Laws should be revoked.

24*th January*.—"On the Architectural Medals and Coins of the Ancients, as illustrative of the Edifices of the Greeks and Romans," by T. L. Donaldson, V.P.

7*th February*.—"An Attempt to develop the Principle which governs the Proportions and Curves of the Parthenon of Athens; with a few Observations on the application of Æsthetic Science to Architecture generally," by D. R. Hay, Esq., F.R.I.E.

A model of an enamelled tile, to be secured on iron rafters, was exhibited by Mons. L. Alaboissette.

The Report of the Committee appointed to investigate Dr. Henszlmann's alleged discovery of the Constructional Laws of Mediæval Church Architecture, was read.

21*st February*.—"A Description of the Artist's Goniameter, used to obtain a correct representation of natural objects," by Henry Twining Esq.

Mr. Twining exhibited the Instrument, and explained the method of using it.

7*th March*.—"On the Methods of Painting upon Glass," by Charles Winston, Esq.

A specimen of Galvanized Iron corroded after seven years' wear in a roof gutter, was exhibited by Mr. Jennings, Fellow.

14*th March.*—At a Special General Meeting, the Resolution of the Council, submitting to the consideration of the Meeting that the Royal Gold Medal for the year 1852 should be awarded to Sir Robert Smirke, R.A., was read and unanimously agreed to.

The Report of the Council relative to the Essays received in competition for the Medals of the Institute, and the Premium in Books to the Students' Class, was read and confirmed, and the Prizes were adjudged as follows:—

To Mr. Chas. T. Hargrave, C.E., for his Essay "On the Construction of Walls, as influenced by local circumstances and the materials most readily available."	*A Silver Medal of the Institute.*
To Mr. John H. Chamberlain, for his Essay "On the introduction of Colour, including Paintings in Fresco, to promote or heighten the effect of Architectural Composition generally." . . .	*A Silver Medal of the Institute.*
To William George Coldwell, Associate, for his Essay "On the advantage to Architecture which has resulted, and what further advantage may be derived from the use of Iron, both as to construction and embellishment."	*A Medal of Merit.*
To Mr. James Thomas Knowles, Jun., for his Essay "On Architectural Education." . . .	*A Medal of Merit.*
To Mr. T. A. Britton, Student, for his "Sketches for the Month."	*A Premium in Books.*

4*th April.*—"On the Decorative Painting of Pompeii" (written in Italian) by Signor G. Abbate, of Naples.

A translation of the Paper was read, and some remarks illustrative of the same subject were made by M. Digby Wyatt, Associate.

A Letter was read by the President, conveying to his Lordship, by command of the Queen, the entire approbation of Her Majesty and H.R.H. the Prince, of the presentation of Her Gold Medal to Sir Robert Smirke, Honorary Fellow, R.A.

A Letter was read by the Honorary Secretary, from Sir Robert Smirke, acknowledging the honor conferred upon him by the award of the Royal Gold Medal, and his gratification at receiving such an expression of the favorable opinion of the Members of the Institute.

The Medals and the Premium in Books awarded during the Session were presented by the President; Mr. Sydney Smirke, Fellow, attending, to receive the Royal Gold Medal, on behalf of his brother Sir Robert Smirke.

A frame containing 22 Bronze Medals, portion of a series intended to serve as a Medallic History of Architecture, by Mr. Wiener; and one of a set of twelve Girandoles for the Library at Coolhurst, by Mr. W. Rogers, were exhibited.

18*th April.*—"A Description of the Panopticon, with details of the Construction and Decoration," by T. H. Lewis, Fellow.

Some elaborate Wood Carvings were exhibited by Mr. Rogers.

Illustrations of the different subjects treated in the Papers were exhibited at all the Evening Meetings.

MEDALS AND PRIZES AWARDED.

ROYAL GOLD MEDAL.

1848. C. R. COCKERELL, R.A.
1849. CAV. L. CANINA, Hon. & Cor. Member.
1850. C. BARRY, Fellow, R.A.
1851. T. L. DONALDSON, Fellow.
1852. CHEV. LEO. von KLENZE, Hon. & Cor. Member.
1853. SIR R. SMIRKE, Hon. Fellow, R.A.

INSTITUTE MEDAL.	SOANE MEDALLION.	MEDAL OF MERIT.	PRIZE BOOKS.
1836. Geo. Godwin, Associate.	——	——	1839. W. Clerihew, Associate.
			1843. A. Johnson, Student.
1838. W. W. Pocock, Associate.		1838. G. E. Laing, Architect.	1844. A. J. Baker, ditto.
	1838. S. Sharp, Associate—	1839. W. W. Pocock, Associate.	1844. W. W. Deane, ditto.
1840. Herr Hallmann.	1839. S. Sharp, Associate.	1839. E. Hall.	1845. G. Judge, ditto.
1841. E. Hall.	(The Medallion with a gold rim.)		1845. W. W. Deane, ditto.
1842. Anonymous, with motto—			1846. G. Judge, Jun., ditto.
(Alas! what perils do environ.)			1846. S. J. Nicholl, ditto.
1843 E. Chamberlain.	1842. J. W. Papworth, Associate.	1843. J. W. Papworth, Associate.	1847. W. Boutcher, ditto.
			1847. S. J. Nicholl, ditto.
			1848. Bright Smith, ditto.
1845. S. J. Nicholl, Student.	1843. A. Johnson, Student.	1846. S. J. Nicholl, Student.	1848. T. Hill, ditto.
1846. Chevalier Beuth.		1846. J. F. Wadmore.	1849. T. Hill, ditto.
1846. T. Worthington.		1847. J. Bell, Associate.	1850. Bright Smith, ditto.
1847. J. W. Papworth, Fellow.			1852. B. Fletcher, ditto.
1848. H. B. Garling, Associate.			1852. W. Lightly, ditto.
1849. Wyatt Papworth.		1852. J. T. Knowles, Jun.	1852. W. Lightly, ditto.
1853. J. H. Chamberlain.	1848. J. Maclaren.	1853. W. G. Coldwell, Associate.	1852. T. C. Tarring, ditto.
1853. C. T. Hargrave.		1853. J. T. Knowles, Jun.	1853. T. A. Britton, ditto.

SUBJECTS FOR MEDALS TO BE AWARDED IN 1853.

Extracts from the Minutes of the Ordinary General Meeting, held on Monday, 4th April, 1853.

ROYAL MEDAL.

Her Majesty having been pleased to grant her gracious permission for the Royal Medal to be conferred on such distinguished Architect or Man of Science, of any Country, as may have designed or executed any building of high merit, or produced a work tending to promote or facilitate the knowledge of Architecture, or the various branches of Science connected therewith.

That the Council do proceed, in January 1854, to take into consideration the appropriation of the Royal Medal accordingly.

INSTITUTE MEDAL.

That the Silver Medals of the Institute be awarded to the Authors of the best Essays on any subjects tending to promote or facilitate the knowledge of Architecture, or the various branches of Science connected therewith.

The Essays to be accompanied by suitable illustrations.

N.B. Each Essay to be written in a clear and distinct hand on alternate pages.

SOANE MEDALLION.

That the Soane Medallion be awarded for the best design for any of the following subjects :—

A Metropolitan Railway Station for a Main Line on the Ground Level; a General Cemetery; or a Town Hall for a large Municipality.

The buildings respectively to be adapted for an isolated position. The plans, elevations, and sections of the buildings to be drawn to a scale of $\frac{1}{8}$ of an inch to a foot. Perspective views and such other drawings to a larger scale as the Candidate may consider necessary for the perfect development of his design. The drawings to be tinted with Indian ink or Sepia.

The successful Competitor, if he go abroad, will be entitled to the sum of £50. at the end of one year's absence, on sending satisfactory evidence of his progress and his studies.

N.B. The competition for the Soane Medallion is open to all Members of the Profession under the age of thirty years.

DIRECTIONS FOR CANDIDATES.

Each Essay and set of Drawings is to be distinguished by a mark or motto, without any name attached, and to be accompanied by a sealed Letter, enclosing the name of the Author, and having on the outside the same mark or motto as that attached to the Essay or Drawings, with an Address to which a communication may be sent. The packet directed, *To the Honorary Secretaries of the Royal Institute of British Architects,* and marked *Essay for Medal* (or) *Drawings for Medal (Motto)*, is to be delivered at the Rooms of the Institute, on or before the 31st of December, 1853.

The Institute will not consider themselves called upon to adjudge a Premium, unless the Essays or Drawings shall be of sufficient merit to deserve that distinction; if the best Essay or Drawing should be by a Candidate who has been successful on a former occasion, they reserve to themselves the power of adjudging such other adequate reward as they may think fit, and of awarding the Medals offered to the second in merit. The Essays to which Premiums are awarded, become the property of the Institute, to be published by them if thought fit. In case they are not published within six months after the award of the Medals, the authors will be at liberty to publish them. The Drawings will be returned to all the Candidates, on application, the unsuccessful ones, after the adjudication, and the successful ones after the presentation of the Medal.

Copies of this Paper, or any further information, may be had on application to the Secretaries, by letter pre-paid.

PAPERS

READ AT

The Royal Institute of British Architects,

SESSION 1854—55.

USUI CIVIUM, DECORI URBIUM.

LONDON:

PUBLISHED AT THE ROOMS OF THE INSTITUTE, 16, GROSVENOR STREET.

1855.

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EXTRACTS FROM A PAPER ON THE APPLICATION OF THE HARMONIC LAW OF NATURE IN THE ORTHOGRAPHY OF ARCHITECTURAL DESIGN;—ILLUSTRATED BY A GOTHIC ELEVATION, SIMILAR TO THAT OF THE EAST END OF LINCOLN CATHEDRAL.

By D. R. Hay, Esq., F.R.S.E.

Read at the Ordinary General Meeting of the Royal Institute of British Architects, November 13th, 1854.

In this communication Mr. Hay showed how the harmonic law, described and applied to the front elevation of the Parthenon at Athens, in his former Paper,* might be similarly applied and made to operate in the construction of a Gothic elevation; his object being a further attempt to prove that there really does exist a mathematical law coinciding with the harmony always found in nature, and that this law can be applied to impart orthographic beauty to architectural structures of any order or style.

He explained numerically the simple nature of the law of harmonic ratio—a law which is found operating in the force of gravity; in the planetary movements; in heat, light, electricity, and chemical affinity; in the forms of animals and plants; and in the perceptions of the human mind.

The first numerical rule is, that any number, to be harmonic, must either be one of the four first multiples of 1—viz., 2, 3, 5, and 7—or a multiple of one of these simple numbers. This rule is based upon the simple fact, that the three first numerals, 1, 2, 3, embody all the principles of harmony, and it is by their simplest modes of union that the above four governing elements are produced.

The second rule is, that, for the practical application of these harmonic numbers, they must be formed into a series of scales, arranged in such a manner that the most simple be made to form the primary or governing elements.

The third rule is, that, in employing these numbers as divisors, the parts of whatever is divided must be integral parts.

The simple elementary figures which may be combined in an architectural design are—

The square, and its curvilinear figure, the circle.
The oblong rectangle, and its curvilinear figure, the ellipse.
The isosceles triangle, and its curvilinear figure, the composite ellipse.

The basis of his theory being that the eye estimates proportion not by distance, but by angular direction, it follows that each of these figures is governed in its individual proportions by a particular angle, and that their harmonic combination in architecture is likewise governed by angles. This being the case, there must be a fundamental angle, to which all other angles so employed should harmonically relate as an integral part.

Now, as the employment of these figures in architectural composition demands that their axes, whether equal or unequal, should be in the horizontal and vertical lines, and as the meeting of these lines makes the right angle, that angle must, in this case, necessarily be taken as the fundamental angle.

* Read February 7, 1853; afterwards printed, and forwarded to the members of the Institute. It was subsequently published, with illustrations, by Mr. Hay.

The manner of applying the law of numerical ratio, in the construction of these six elementary figures, having been fully explained in his former communication, as well as in several of his published works, he confined his illustrations to a few simple examples of its effect in harmoniously arranging groups of rectangles.

Four scales of harmonic parts of the right angle being obtained by dividing the quadrant of a circle by elementary harmonic numbers, some of these are employed to form diagonals to a series of rectangles. It is the nature of harmonic ratio, as applied to form, to require that, when any two geometric figures are placed in juxta-position, in order that a proper contrast be produced, their respective proportions must bear a distinct and definite ratio to each other. (This was illustrated by eight groups of rectangles, selected from the foregoing series.)

The east end of Lincoln Cathedral is, in the general arrangement of its parts, decidedly a vertical composition, while that of the Parthenon is decidedly a horizontal one. The first is composed of seven vertical parts, divided horizontally into bases, windows, and tracery, ending in a series of seven acute angles. The second is composed of three horizontal parts, vertically divided into columns, triglyphs, and metopes, and surmounted by one obtuse angle. Notwithstanding the difference of character thus existing between these examples, it is confirmatory of the truth of the system, and the great scope of its usefulness, to find that the proportions of the one style are as susceptible of the application of this harmonic law as those of the other.

The fundamental angles in the front of the Parthenon had been shown to be the following :—

(1)	$(\frac{1}{2})$	$(\frac{1}{3})$	$(\frac{1}{5})$	$(\frac{1}{7})$	$(\frac{1}{9})$	of the Right Angle.
	$(\frac{1}{4})$	$(\frac{1}{6})$	$(\frac{1}{10})$		$(\frac{1}{18})$	
	$(\frac{1}{8})$					
	$(\frac{1}{16})$					

Those he had employed in the construction of the Gothic front are :—

(1)	$(\frac{1}{2})$	$(\frac{1}{3})$	$(\frac{1}{5})$	$(\frac{1}{7})$	$(\frac{1}{9})$	of the Right Angle.
	$(\frac{1}{4})$	$(\frac{1}{6})$	$(\frac{1}{10})$			
		$(\frac{1}{12})$				

The Parthenon being, as already observed, a horizontal composition, the principal angles were made with the horizontal line. In the present case, the composition being vertical, the principal angles, nine in number, are made with the vertical line.

Having in recent works pointed out the operation of this law of nature, in the constitution of that beauty of form and proportion by which the human figure is distinguished above all other works of creation, as also the application of the same law by the ancient Greeks, in those inimitable sculptures by which they represented the figures and attributes of their various deities during the best period of art the world ever knew ; having afterwards discovered that the same law, similarly applied by the same people during the same period, governed the general form and the relative proportions of all the parts, as well as all the curves, of the details of that unequalled monument of architectural chasteness and beauty, the Parthenon of Athens; and having on the present occasion shown that the same law, similarly systematised, is equally calculated to govern the form and proportions of Gothic architecture, it might be asked what further proof is required to establish the fact, that there really is a mathematical law coincident with the harmony of nature, and applicable to building ?

In illustrating this latter proof of the existence of such a law, he adopted the design of one of the most beautiful and perfect remains of those interesting monuments of the piety of our ancestors which he could find; and although not enabled to ascertain with sufficient certainty that the law in question was really applied in the execution of this design, yet the approximation to a perfect development is so close as to suggest that it really was, although perhaps in a less perfect manner. From this latter fact the probability suggests itself, that a system of applying this law of nature in architectural construction was the only great practical secret of the Free-masons; all their other secrets being connected, not with their art, but with the social constitution of their society.

It can scarcely be doubted that there were some such practically useful secrets amongst the Free-masons, or early Gothic architects; for we find, in all the venerable remains of their art which exist in this country, symmetrical elegance of form pervading the general design—harmonious proportion amongst all the parts—beautiful geometrical arrangements throughout all the tracery—as well as in the elegantly symmetrised, foliated decorations, which belong to that style of architecture. But it is, at the same time, worthy of remark, that whenever they diverged from architecture to sculpture and painting, and attempted to represent the human figure, or even any of the lower animals, their productions are uniformly such as to convince us that in this country these arts were in a most degraded state of barbarism—the figures are grossly disproportioned, and often much distorted in their attitudes; the subjects they represent are paltry in composition, and puerile in conception; while their representations of animals and chimeras are whimsically absurd. It would therefore appear that architecture, as a fine art, must have been preserved by some peculiar influence from partaking of the barbarism so apparent in the sister arts of that period.

Pythagoras, who is said to have acquired his knowledge of the harmonic law of numbers from Egypt, formed, it would appear, a system much more perfect and comprehensive than that practised by the Free-masons in the middle ages of Christianity; for it was as applicable to sculpture, painting, and music as it was to architecture. This perfection in architecture is strikingly exemplified in the Parthenon, as compared with the Gothic structures of the middle ages; for it will be found that the whole six elementary figures already enumerated as belonging to architecture are required in completing the orthographic beauty of that noble structure,—and, amongst these, none conduce more to that beauty than the simple and composite ellipses. Now, in the architecture of the best periods of Gothic, or indeed in that of any after period (Roman architecture included), these beautiful curves seem to have been ignored, and that of the circle alone employed.

Be these matters as they may, the great law of numerical harmonic ratio remains unalterable; and a proper application of it in science and art will never fail to be as productive of effect as its operation in nature is universal, certain, and continual.

The Chairman, Mr. George Mair, Fellow, regretted the absence of Mr. Penrose, who was so well qualified to appreciate a question to which Mr. Hay had evidently given a degree of attention and research which entitled him to the thanks of the Meeting.

Mr. Papworth, Fellow, said, it appeared that the elevation exhibited was not *exactly* that of the east end of Lincoln Cathedral, but was only "similar" to it; a matter which he thought very fortunate The external structure of a large church evidently depended upon the internal pillars; and it could hardly be conceived that the end of a church was designed in the first place, and that the whole plan should then be made subservient to that one front. Why, in this case, should either front be chosen? Why not the long side of the building, which was a much more prominent feature? He thought the Institute had got into the difficulty, in such discussions as the present, of very nearly having their

patience exhausted. He had been struck with a remark in Boisserée's Description of Cologne Cathedral, on the use of the central angles of polygons, which led to the inference, that the smaller the comparative size of the base of any portion of a Gothic structure, whether gable, tower buttress, or pinnacle, and the higher its actual position in the structure, so much the taller was its proportion, and so much smaller was the angle at the apex of its covering. He believed this was the only fact constant in the works published on this subject.

The Rev. Mr. Petit, Hon. Member, said he had not studied Mr. Hay's system, but he thought that any system must be very comprehensive indeed which could include all the beautiful and varied proportions of Gothic architecture. Lichfield Cathedral was a remarkable example of the number of different elements which might be taken as the basis of such a system; such as the length of the nave, its proportion to the choir; the width of the central tower, its height above the roof; the height of the building itself; the proportion of the west towers to the centre tower, &c. Such a mathematical system as Mr. Hay's might be made applicable to one particular front, but could hardly apply to all the various component parts of buildings of the Mediæval period.

The Chairman reminded the Meeting of the ceiling of the great room of the Society of Arts, which had been decorated by Mr. Hay, as an illustration of some of his theories.

Mr. C. H. Smith, Visitor, objected strongly to that part of Mr. Hay's paper which had spoken of Gothic sculpture in a depreciating manner. Flaxman had always expressed the highest admiration of those works, and the cathedrals of Salisbury, Worcester, and Lincoln, with Henry the Seventh's Chapel, furnished ample proof that Mr. Hay was either not a competent authority on this subject, or had not sufficiently studied it. These works, moreover, were chiefly by English artists. The monument in Westminster Abbey, to a youthful daughter of Edward the Third, was, it appeared, submitted to competition. The names of five competitors were mentioned in the chronicles, and one of them, who was evidently an Englishman, came up from Gloucester to explain his design, and was allowed a sum of money for his travelling expenses.

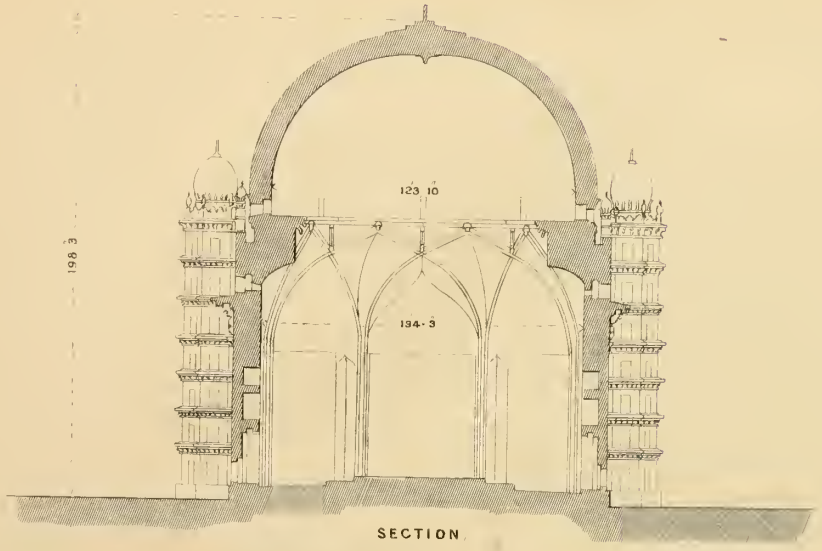
Mr. Beck, Associate, said, it appeared to him that the sense of harmony and proportion in a building was dependent on its harmonising or sympathising with our own system generally, and particularly with the organ by which it was viewed, namely the eye. Neither the eye, nor any other member of the body, could be moved otherwise than in easy flowing curves, and he would ask whether the beauty of such an edifice, as had been under consideration, was not mainly due to its presenting to the eye (which could not embrace the whole at once) such lines as could be easily traversed by the peculiar motion of that organ. At all events, he considered that the harmony which pervaded these structures was something more subtle than could be grasped by numbers.

Dr. R. Dickson, Visitor, strongly concurred with Mr. Smith in the excellence of Mediæval sculpture, and adverted to the opinions of Professor Kinkel, who, in his lectures at the London University, had enforced the same view of the question.

Mr. Nelson, Hon. Sec., spoke to the same effect. It had been obj cted that the statues in the west front of Wells Cathedral were unnaturally tall; but it had been proved that this was intentional, in order to give them a proper effect when viewed from below. He especially referred to the beauty of the sculptured foliage in the capitals and other parts of ancient Gothic churches.

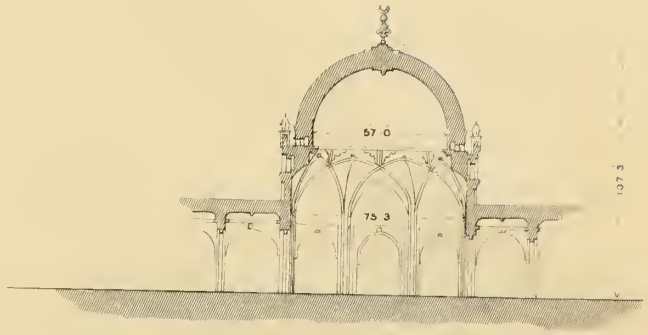
Thanks were voted to Mr. Hay, and the Meeting adjourned.

THE GOL GOOMUZ
BEEJAPORE.

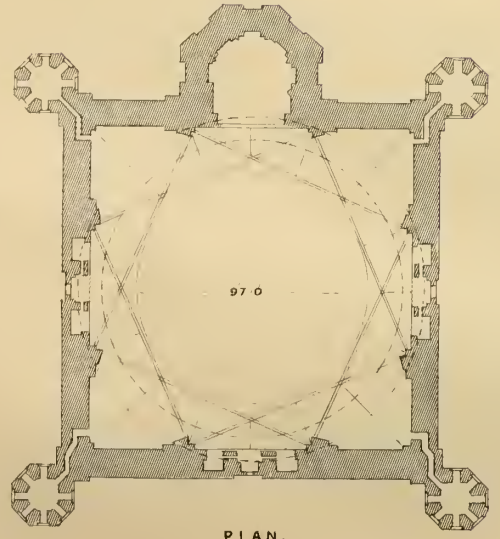


SECTION

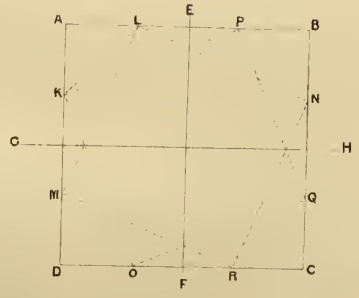
THE JUMMA MUSJEED.
BEEJAPORE.

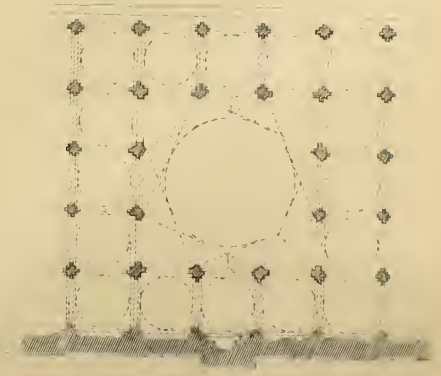


SECTION



PLAN.





PLAN.

Scale
10 0 10 20 30 40 50 60 70 80 90 100 10 20 30 40 50 60 70 80 90 200 Feet

Vincent Brooks lith. King St. Covent Gdn

ON THE ARCHITECTURAL SPLENDOUR OF THE CITY OF BEEJAPORE.

By James Fergusson, Associate, F.R.A.S.

Read at the Ordinary General Meeting of the Royal Institute of British Architects, Nov. 27th, 1854.

It is, perhaps, unfortunate for me that the subjects on which I have on former occasions had the honor of addressing the Institute, have been either purely Oriental, or so connected with the far East, as to be beyond the usual range of an Architect's studies, and that consequently they could not be expected to excite the same interest as the more familiar styles of the West.

On the present occasion the same objection still applies. The subject is again Indian, but the style is the Saracenic, which is more familiar to us from the buildings at Granada and Cairo, now tolerably well known to Europeans; and one of the buildings I shall have this evening to describe, is so remarkable, both for artistic and constructive excellence, that it must in future take rank among the principal buildings of the world, and no one will venture hereafter to write a Treatise on Domes, without including the Tomb of Muhammed of Beejapore, as one of the most remarkable specimens of its class.

Before proceeding further, I may as well mention that I have never myself been able to visit that city; and that it is one of the very few capitals of the East which I have not personally examined. Till lately this was a subject of bitter regret to me; though I now rather congratulate myself on the accident, for it was this omission that led me to urge my friend Col. Sykes to try and procure such drawings as might at least make the dimensions and construction of its buildings intelligible. With that zeal for science for which he is so well known, and that energy which characterises all he does, Col. Sykes has far exceeded my requisition, and has procured from India by far the finest set of drawings that have ever come from that country, and which, as far as they go, leave nothing to be desired.

These drawings, some of which are now suspended on the walls, were made under the superintendence of Capt. Hart, of the Company's Engineers, principally by Mr. A. Cumming, an uncovenanted District Revenue Surveyor in the Company's service, with the aid of native assistants.

Before, however, describing the drawings, allow me to point out as succinctly as possible, who the men were who erected these wonderful buildings. You will recollect that Mahmoud of Guznee's famous raid to Somnath was the first great Mahomedan invasion of India; he, however, made no permanent settlement on our side of the Indus, and it was not till two centuries later that Kutub-u-Deen established himself at Delhi, in the year 1206; he was the actual founder of the Patan dynasty, which lasted for nearly three centuries. Towards the end of that period, like all Eastern dynasties, it tended to decay, and the remoter provinces were enabled to assert their independence, and establish themselves as separate sovereignties, first in Bengal, then in Goozerat, so that in course of time six separate kingdoms were established in the Deccan, or within the limits of what is now the Bombay Presidency.

One of the last and least of these was Beejapore, which became independent in the year 1501, under Yusuf Khan, a son of Amurath II, of Anatolia. The first three or four kings did nothing very remarkable, and are buried at Gooke near Sholapore, but on the defeat of Ramraj, of Vyjanuggur, their successors became rich and powerful, and adorned the capital with the buildings illustrated

in the drawings, during the century that elapsed between that event and the final subjection of the kingdom by the Tyrant Aurungzebe, in 1685.

THE FOLLOWING ARE THE PRINCIPAL DATES WHICH IT IS REQUISITE TO BEAR IN MIND WITH REFERENCE TO THE PRESENT SUBJECT :—

			A.D.
Mahmoud of Guznee			997
Conquest of Delhi (Kutub)			1206
Baber			1494
Mogul Dynasty established			1554
1. Guzerat	1319	1584	
2. Malwa	1387	1568	
3. Kandeish	1370	1596	
4. Ahmednuggar	1490	1607	
5. Golcondah	1512	1672	
6. Beejapore	1489	1660	
Ibraham II	1579		
Muhammed	1629		
Ally Adil Shah	1660		
Aurungzebe			1658
Aurungzebe died			1707

The 74 drawings now sent home illustrate two Tombs, those of Muhammed and Ibrahim, one Mosque, one Palace, one Private Residence, and one Bowree or tank. You must not, however, suppose that these are all the buildings worth seeing in this remarkable city. There is no illustration of the walls of the citadel and town, the former $1\frac{1}{4}$, the latter $6\frac{1}{4}$ miles in extent, and with their bastions and gateways perhaps the most remarkable feature of the whole. There are no illustrations of the seven palaces within the citadel (one seven stories in height), which, as the residence of the kings, were the richest and most beautiful buildings; none of the other tombs, mosques, and palaces of the nobles, which crowd every part of the city, and would require at least two or three times the number of the present drawings to make them intelligible.

The most remarkable building is the Tomb of Muhammed.* It consists of a square apartment, measuring 135 feet each way. At the height of 57 feet from the floor line, it begins to contract by an arrangement of pendentives, as ingenious as beautiful, to a circular opening of 97 feet; on the platform over the pendentives is erected a dome, semi-elliptical in outline but circular in plan, 124 feet in diameter, leaving a gallery more than 12 feet wide all round; the internal height of the dome is 175 feet, the exterior to the apex 198; the general thickness is about 10 feet; at the apex, however, it is nearly 18 feet; yet, if the tradition of the place can be depended upon, it was built wholly without centering.

The most ingenious and novel part of the construction of the dome is the mode in which the lateral thrust is counteracted. In the Pantheon, and in European domes generally, this is counterbalanced by a mass of masonry in the haunches, as is also the case in bridges. This mass, however, entirely destroys the outline and is, to say the least of it, a very clumsy piece of masonry; here the object is accomplished by hanging the weight inside: the massive pendentives having a tendency

* The Gol Goomuz.

to fall inwards act as ties, and effectually accomplish the object without the possibility of derangement to the structure, as from their arch form, they are perfectly stable in themselves.

The external ordinance of the building is as beautiful as the internal. At each angle there is an octagonal tower of 8 stories, simple and bold in its proportions, and crowned by a dome of great elegance. The lower part of each face is plain and simple, pierced only with such openings as are requisite to admit air and light in that climate, and they are not a tenth of what would be required in ours.

At the height of 83 feet, a cornice projects to the extent of 12 feet, nearly double what the boldest European architect ever attempted, and above that an open gallery gives lightness and grace to the whole structure. Above the gallery is an ornamented band of fretwork, which is surmounted by a battlement of great beauty, relieved by eight smaller minarets, two on each face.

On comparing this with other domes, it will be seen that it is the first in area. It covers more ground clear of support, than any dome or vaulted roof in the world; while it is of more difficult construction, being placed over a square hall instead of a circular drum. Considered, therefore, either as a mechanical or as an artistic form it must rank among the first, if, in fact, it be not the most beautiful as well as the largest domical building yet erected in any part of the world.

DIAMETER OF PRINCIPAL DOMES.

Pantheon, Rome	142 feet.
St. Peters, ditto	139 „
Sta. Maria, Florence	139 „
Tomb of Muhammed, Beejapore	135 „
St. Paul's, London	112 „
Sta. Sophia, Constantinople	107 „
Church at Darmstadt	105 „

PANTHEON.		TOMB OF MUHAMMED.	
Internal area of circle	15,833 feet.	Internal area of square	18,360 feet.
Internal area with recesses	19,086 „	Internal ditto with recesses	19,371 „
Whole area of building	27,157 „	Whole area of building	24,964 „
Area of supports	7,477 „	Area of supports	5,593 „
Ratio of supports to area	· 363 „	Ratio of supports to area	· 446 „

Tomb of Ibrahim.*

The other tomb—that of Ibrahim—is a much smaller than that just described, being only 116 feet square over all, and 114 in height to the top of the crescent, but it makes up in richness of detail and in elegance of design for this difference in dimension; and I am not sure that many would not prefer the Corinthian exuberance of this tomb to the Doric simplicity of its great rival.

In plan it consists of an internal apartment, 40 feet square by 35 feet high, covered by a stone ceiling flat in the centre, and slightly coved at the sides; a constructive problem almost as difficult as the great dome of Muhammed's tomb itself, but which has been most successfully accomplished. This apartment is surrounded by a double verandah, flat roofed throughout, and supported on square pillars, with bold and beautiful capitals. Though the walls of the central apartment are plain and unornamented, every part of the exterior is covered with the most elaborately carved ornaments, generally of Hindoo parentage, but interspersed with inscriptions from the Koran, so numerous, that it is said the

* The Ibrahim Rozah.

whole of the sacred book is inscribed on the walls of the tomb. The windows, too, have pierced Arabic inscriptions for tracery, and the whole is coloured, gilt, and finished with a profusion of labour and intricacy of design, which puts the Alhambra and all Western buildings to shame, and can only be found in the far East.

Above the central apartment is one covered by a dome of beautiful proportions and design, though merely meant to occupy the space required to give the necessary height to the dome externally, which, combined with the minarets surrounding it, makes up a group of graceful objects as playful as anything in Gothic architecture, as beautiful in grouping, and far more elaborate in detail.

Attached to all these buildings are mosques and gateways, the former larger than the tombs themselves, and as beautiful in style; but of these we have, unfortunately, no drawings or details.

The next building is the Jumma Musjeed, or great mosque, the Cathedral of the city. It consists of one great apartment, divided by five aisles in one direction and nine in the other into forty-five squares, nine of which are covered by the great central dome, 75 feet in diameter; the remaining thirty-six having each a small flat domical ceiling of great beauty. This building is 258 feet by 144, in front two wings project 188 feet, so as to enclose with the mosque three sides of a court yard of those dimensions. It, no doubt, was intended to enclose the fourth also by a gateway worthy of the mosque and of its position in front of the building. Though commenced by one of the earlier kings of the dynasty, it was left unfinished when the race was overthrown by Aurungzebe. The architecture of the building is remarkable for the elegant simplicity of the details and the beautiful proportions of the parts; and though it has nothing so striking, for size and construction, as the Tomb of Muhammed, or so rich as that of Ibrahim, it may fairly rank as one of the best of the simple and pure style of architecture which so frequently characterizes the early mosques of the Mahomedans in India.

As I before mentioned, the only palace illustrated in the collection is the Ashar Moobaruck, situated just outside the ditch of the citadel. It consists of one block of building, 100 feet by 135. In front is a great verandah, 38 feet deep, supported by four wooden pillars; behind this are various walls and apartments, two stories in height. It cannot pretend to anything like the architectural splendour of the three buildings just described, but is an interesting illustration of the mode in which Indian architects employed wood in their construction. The difference of spacing, of construction and detail, is everywhere apparent, but every thing is as appropriate, and in good taste, as in the buildings of stone.

The building is now used as a relic shrine or temple, being said to contain two hairs of Mohamed's beard, and it is singularly interesting, as a means of comparison with the buildings of Persia; but on this it would not do to enter on this occasion.

The private dwelling* these drawings illustrate is, though small, not the least interesting or beautiful. Although only 24 feet square on the plan, and 50 feet in height, it must have cost more than the building last described. Every part of its walls, floors, and partitions is built of stone, and some parts of it are carved with an elaborateness only to be found in India; still, as will be observed in the drawings, the architects were not afraid of plain surfaces, all the walling being entirely without ornament, which gives value to the more enriched details. We have no buildings in Europe which can compete with this. Such a one as Roslin Chapel, for instance, is coarse and plain in comparison; and except the shrines in the interior of our Gothic Cathedrals, nothing is ornamented to the same extent; but they, of course, are comparatively small, and are objects of internal, not external architecture. Indeed, words can convey no adequate idea of such an edifice as this; but fortunately the drawings are so carefully and beautifully executed as to leave nothing to be desired in the way of explanation.

* The Mehturee Mahal.

The story of this building is curious and characteristic. It is said that an astrologer persuaded the first Ibrahim, who was a weak prince, that the only way to escape a great impending misfortune, was to give a large sum of money to the first man he should see on rising on a certain morning —meaning, of course, to be himself the man. The king, however, troubled with the idea of his destiny, rose earlier that morning than usual, and the first person he saw was the mether, or sweeper, who is always in India a man of the lowest caste, and who was performing his menial office at that early hour; he in consequence got the money, and employed it in building this gateway, which was to lead to a dwelling and mosque in the court-yard within. Only this part of the design was, however, completed; but enough has been done to shew that, though his caste was low, his Hindoo blood led him to appreciate elegance with even more taste than his lordly masters, which he has done in the richest and most elegant specimen of architecture in even this wonderful city.

The remaining building* illustrated by these drawings is a bowree, or large tank, surrounded by stone steps, and with arches and gateways, a form of architecture peculiar to India, and interesting, as showing how any object may be made architecturally beautiful, whatever it may be. The present is neither so large nor so splendid as other specimens that might be selected. Its form and details, however, are as elegant as those of the other buildings of the city, and well worthy of a careful examination.

Such, then, are six of the buildings of Beejapore, selected out of the forty-one mentioned in the plan of the city; but even that does not include all, for the suburbs which are beyond its range, contain both palaces, mosques, and tombs well worthy of attention; and although these six may be considered as the principal buildings, there are many others as rich and ornate; and although perhaps on a smaller scale, still, in the aggregate, as worthy of illustration — so that it would require many more drawings to make up a worthy representation of the architectural splendour of the city of Beejapore; and when you recollect that this is only a provincial city, once the capital of an ephemeral dynasty, which hardly existed independent for more than a century, you will easily understand that they do not exaggerate who speak in glowing terms of the wonders of the imperial cities of Agra and Delhi, and of the ruins still to be found in other provincial capitals, and assert that there are architectural forms in India well worthy of the attention of the architects of Europe.

Mr. Papworth, Fellow, did not perfectly understand the manner in which Mr. Fergusson seemed to think that the walls of the Gol Goomuz were relieved from the outward thrust of the dome, and would feel obliged by some further explanation on that point.

Mr. Fergusson, in explanation, made a rough sketch, illustrating, first, the tendency of domes and arches to break outwardly; secondly, the mode in which that tendency was counteracted in the Pantheon by a mass of masonry externally; and thirdly, the way in which it appeared to him that the same object was accomplished in the Gol Goomuz by a corresponding mass of pendentives internally. The effect of the latter arrangement, drawing the mass inwards, was equivalent to that of the external masonry opposing outward pressure in the case of the Pantheon.

Mr. Papworth pointed out the object of loading an arch or dome at such a point as in the Pantheon, viz. to prevent its spreading *at the haunches;* but the difficulty he felt was as to the *upright walls* of the Gol Goomuz. It appeared to him that the beautiful arrangement of the pendentives in that building was merely ornamental, and had nothing to do with the construction or the statics of the dome, which latter was a solid and independent construction.

Mr. Donaldson, H.S.F.C., considered that the weight exercised by such a dome *at the springing* would be so great as to thrust out the walls but for the weight inside provided by the pendentives,

* The Taj Bowree.

which acted as a counterpoise He did not understand Mr. Fergusson to allude to the construction of the dome itself, but to the counteracting effect of the pendentives.

Mr. Fergusson explained that the arrangement referred to gave the dome a basis so solid that it could not thrust the walls outwards; a mass, indeed, upon which the dome rested as it would upon the ground.

Mr. Donaldson suggested that the form and substance of the dome were such as would ordinarily be deemed contrary to sound construction, and inquired whether there was not something in its internal construction, (either timber or a highly adhesive mortar) to account for its holding together.

Mr. Fergusson said that was not the case. The dome was entirely of brick and mortar, and the common tradition of the place was, that it was built without centering of any kind, merely by the aid of a pillar in the centre, with a moving arm or guide-pole. He knew that small domes were thus erected in the East at the present day.

Mr. Thompson, Fellow, considered that Mr. Fergusson's explanation of the principle of construction was perfectly clear, and that the arrangement described was exceedingly novel and ingenious; adding (as he conceived) three times their original resistance to the otherwise slight and insufficient upright walls.

Mr. Fergusson further stated that the mass of masonry in the pendentives was probably equal in weight and mass to twice that of the whole quantity of brick-work in the dome, thus effectually resisting any thrust from what was in fact the smaller mass. The angles in some respects resembled fan-groining, and it would be observed that the dome stood in fact nearly *within* the *inner* side of the upright walls.

The Chairman, Mr. F. C. Penrose, V.P., observed that Col. Sykes was present, and would probably offer some remarks upon the subject. Perhaps he would be able to state whether the pendentives were corbelled inwards with horizontal joints, or with radiating joints, because the principle of the construction would depend very much on that point. The adoption of the arch principle with radiating joints, and with key-stones in the enormous open ring beneath the dome, would defeat the object, and help to press outwardly; whereas if the mass were corbelled inwards with horizontal joints, an effectual power of sustaining the dome would be obtained.

Colonel Sykes, Visitor, begged in the first place to disclaim a large portion of the praise bestowed upon him by Mr. Fergusson in reference to the drawings before the meeting. He had simply been the means of their appearance in this country, and the gentleman through whose zeal and taste the work was accomplished was Mr. Frere, the present Commissioner in Scinde. The position of that gentleman, as the successor of the late Rajah of Sattara, enabled him to give orders for the drawings, which had been executed by an European Officer of Engineers, with the assistance of some native artists, both Mahommedan and Hindoo. He (Col. Sykes) had himself spent a week or ten days at Beejapore in the year 1818, and examined the buildings represented with much interest and delight; but he did so only as an amateur, and was unable to answer the Chairman's question. He believed the drawings, however, were so perfect, that they would supply the information required. With respect to the use of timber, he observed that there might have been some employed in the *Mehturee Mahal*, which was a private residence; but the other buildings were entirely of stone, excepting the great Goomuz, which was of bricks united by means of the celebrated chunam which held them together with great tenacity. All the decorative work, carvings, windows, &c. were of stone enriched with patterns of the greatest variety and beauty, embracing indeed all kinds of forms except those representations of animated nature which were forbidden by the Mahommedan religion. He could not adequately express his admiration of the taste and elegance of design and harmony of colouring displayed in the works of India, from the most northern cities down to Beejapore, both Mahommedan

and Hindoo. Beejapore was now a city of ruins, the spaces between these splendid buildings being partially cultivated, and the mass of the population living in the surrounding country.

Mr. Cockerell, Fellow, concurred with Mr. Fergusson in admiring the curious, novel, and highly interesting mode of construction which he had explained in the Gol Goomuz, and the effect of which might be easily understood, as providing a platform on which the dome might safely rest, although the walls below were comparatively slight. Before, however, they, as architects, could profit much from the construction of this dome, it was necessary to have many further particulars, in order effectually to compare it with the works of our own quarter of the globe, and especially with the great work of Brunelleschi. The *outline* of those oriental domes (differing as it did from that adopted by the great Italians) rendered them exceedingly interesting; and it would be very desirable, if possible, to pierce their walls, and ascertain whether they had any chain bonds or other similar contrivances, and in short to compare them minutely with the great dome of Brunelleschi. The latter (like the human dome, the skull) was a double construction, possessing solidity and thickness with comparatively little weight, whereas the dome now under discussion was solid throughout, rendering the weight enormous, and the structure much more difficult; although, at the same time, much less scientific. He hoped, therefore, that the comparison he suggested might be carried out. He begged to ask Mr. Fergusson whether he had found in these remains a school of ornamental art, such as might have arisen out of the school of the Arabs, who were so renowned for their beautiful geometrical combinations and exquisite taste.

Mr. Fergusson, in reply, observed that every nation which set out honestly to work out a problem in art, and to improve in every work on those which had gone before, had succeeded in producing a true and perfect school of art. It was thus with the Egyptians, the Greeks, and the Romans, as well as in Gothic, Saracenic, and even in Mexican and Indian architecture. The Hindoos and Mahomedans, when they began to build domes, built small domes; these were successively enlarged and improved till they attained the perfection now described. And in the same manner with ornamental art: the most beautiful details in the most perfect of these works could be traced back for centuries in their gradual progress from rude or clumsy mouldings. And it was remarkable that the Mahommedans in India had engrafted upon their own Saracenic style many features and ornaments from Hindoo architecture. Mr. Fergusson proceeded to explain that the peculiarly obtuse angle at which the pendentives cut across the apartment, had a great effect in reducing the outward thrust, which was not one-tenth so great as if they had been placed at an angle of 45 degrees. Moreover, the thrust was by this arrangement carried into the great pillars or minarets at the corners of the building; becoming practically *nil*. He could assure the meeting that the dome was a solid mass of brick-work. There were many ruined domes in India, which had fallen down, and in all cases they had been solid masses, the tenacity of the materials precluding all danger, unless the foundations gave way. He had witnessed in India the construction of a vaulted apartment 200 feet long and 110 feet high, with a span of 58 feet, similar to our own Gothic vaults, the vault being 10 or 12 feet thick. This was effected by raising a rude scaffolding in the centre, and forming a mould of the intended vault in clay, upon which they threw in masses of concrete. The heat of the climate soon rendered this thoroughly dry, when the scaffolding was struck, and the vault remained as perfect as possible, and would probably last for centuries, although there was not a single moulded stone in its construction. Many vaults in India, constructed apparently in a similar way, had lasted four or five centuries, and therefore the tenacity of material in the great dome at Beejapore was less surprising.

Mr. Baker, Associate, suggested that it might be a question of bond. If the bonding of the brickwork were perfect, the thrust would be very well resisted.

Mr. Fergusson concurred.

Mr. I'Anson, Fellow, expressed his sense of the obligations of the Institute to Mr. Fergusson for his admirable paper. Beautiful as the drawings were, they were evidently insufficient to enable an architect to reproduce the original works, and he confessed he did not understand the principles of that peculiar mode of construction which had been discussed. It was much to be regretted that this powerful country, with its immense possessions in India, had not done anything towards describing and illustrating these interesting monuments; a work which he felt sure would be gladly undertaken by many young and rising architects as a matter of study.

Mr. Donaldson highly eulogized the beauty, minuteness, and obvious accuracy of the drawings, and the amount of knowledge shown hy the mode in which the sections were prepared. He hoped, indeed, that the Institute would refer it to the Council to take such steps as they might think proper, with a view to induce the Directors of the East India Company to have them lithographed and published. He moreover thought it would be highly desirable if permission could be given to exhibit these drawings next year in Paris, where, he felt confident, they would excite the strongest curiosity and interest.

Mr. Cockerell fully concurred in the views expressed by Mr. Donaldson.

The Chairman stated that Colonel Sykes had kindly permitted the drawings to remain at the Institute till the next meeting, with a view to the further discussion of the subject; and he hoped on that occasion that some members would come prepared with plans and sections of European domes, in order to carry out the interesting comparison suggested by Mr. Cockerell.

Mr. Donaldson proposed a vote of thanks to Mr. Fergusson. His knowledge of the history of India, and his previous study of collateral styles of architecture, pre-eminently qualified him to do justice to this interesting subject; and the simplicity, and at the same time the vigour, with which he had brought it before the meeting, fully entitled him to their best thanks.

The Chairman had much pleasure in following Mr. Donaldson, by proposing a separate vote of thanks to Colonel Sykes for allowing the drawings to be displayed.

Colonel Sykes, in returning thanks, observed that the acknowledgments of the meeting were really due to the Directors of the East India Company, who deserved much praise for their liberality. The Museum of the East India House contained many other interesting objects, which might be made public with great advantage.

Mr. Donaldson and Mr. C. H. Smith, Visitor, confirmed this statement from their own experience, and the latter suggested that the members of the Institute might, with great advantage, devote a morning to the inspection of the drawings, &c. in the Museum.

The votes of thanks were carried by acclamation.

ELMES' TESTIMONIAL.

Mr. Cockerell said, that by the permission of the Council, he begged to lay the subscription list of the Elmes' Testimonial on the table, and to invite the co-operation of the Institute in promoting its object, both as a recognition of the extraordinary merit of their lamented professional brother, and as a duty to the profession itself, so admirably sustained and dignified by his genius and labours. He then proceeded to point out some of the most remarkable features of St. George's Hall at Liverpool, in which he showed, by a comparison of the vaulted ceilings of Diocletian's and Caracalla's baths, that Mr. Elmes had exceeded the Romans, that he had equalled the greatest efforts of the art in modern Europe, and had surpassed every architectural production of this country in the present century. Mr. Elmes might be called a meteor in the architectural world: at the age of 23 he obtained the premium

for St. George's Hall; at 24, that for the Assize Courts; at 25, he incorporated the two, and carried out the structure in the main, during the eight remaining years of his brief but brilliant life, which terminated at the age of 34, in Jamaica. The Corporation contracted with their architect to give him 5 per cent. on his own estimate of £97,000., including the premium in the competition, and all travelling expences, no addition being made for the many extras from his designs, ordered by themselves, in carrying out the work. At his death, 5 per cent. on the amount of work done up to that period, was paid to his widow, and a present of £375., in consideration of drawings, &c., and the unhappy circumstances attending his premature decease. On these profits he had honourably effected the insurance of his life, and had provided for the necessities of his father; but owing to his informality in not arranging conditions with the insurance office on leaving the country, half of the insurance was forfeited, leaving to his widow, a lady of great accomplishments, and his orphan son, an income of only £62. per annum, to which her mother's protection, and her teaching music, made some small addition. Under these unhappy circumstances, it had been his (Mr. Cockerell's) obvious duty, as his successor in the work, and the wish of his friends and admirers in Liverpool and elsewhere, to raise the means of adequate provision for the relict of so admirable a man, and he had to report that about £618. had already been raised by the people of Liverpool, and about £492. by architects, engineers, and some noble lords, and strangers. He was sorry to say that, hitherto, some of the most conspicuous names of the merchant princes and capitalists of the richest commercial mart of England, Liverpool, had not been added to the list, though he did not doubt that they would be in due time. A noble Lord, politically connected with Liverpool, had at first declined to subscribe, because he considered, "that the people of Liverpool, so honoured and benefitted by the work, would monopolize the right of providing for the widow and orphan;" and some of our own profession, conspicuous for liberality, had hitherto declined from the same cause. Mr. Cockerell looked, however, confidently to the countenance which the Institute would give to the testimonial, not as a moneyed corporation, for they had no means at their disposal, but as a body of individuals always alive to such considerations, and second to no Society in the metropolis for true liberality and enlightened patronage of genius and merit.

The meeting then adjourned to Monday, December 11th.

Correction in the Discussion, November 13th:—page 4, line 22, *for* Edward the Third, *read* Henry the Third.

ON THE GREAT DOME OF SULTAN MUHAMMED'S TOMB AT BEEJAPORE.

Being a Discussion (in continuation) held at the Ordinary General Meeting of the Royal Institute of British Architects, December 11th, 1854.

Mr. Fergusson, Associate, said—As there are no doubt many persons present on this occasion who were not here this day fortnight, and consequently did not hear what then passed, I have been asked to recapitulate briefly what I said, not with regard to the general subject of the architectural splendour of Beejapore, but with especial reference to the artistic and constructive merit of the great Dome of Sultan Muhammed's Tomb, to which the discussion this evening is to be confined.

Before doing so however allow me to go a little back in the history of domes. The first great example which it is necessary to quote is the Pantheon, which is raised on a circular apartment or drum, as were all the earlier domical tombs of the Etruscans and Romans. The inconvenience of this form was however early felt, and an octagonal one was adopted, and then a square, the angles of which were cut off, so as to form an octagon internally, and then the triangular blocks in the angles were hollowed out into great niches, so that very little space was lost. In course of time the head of the niche became an arch, springing from wall to wall, and so formed what may be called the Roman pendentive. It was generally brought down to the ground by a vaulting shaft, but that was of little or no constructive use.

The Byzantines made an advance on this by filling up the angles of the building with a bold bracket springing from each angle, with a vaulting shaft in the corner, which gradually extended forward till it formed the octagon at the springing of the dome.

The Saracenic architects used both these forms; though it may perhaps generally be asserted that in the western world they preferred the Byzantine; in the eastern the Roman pendentive. In India there are some noble examples of both classes. In that country, after having produced the octagon they generally cut off the angles again, so as to produce a polygon of sixteen sides, and in large examples repeated the operation, so as to have one of thirty-two, which is practically so near a circle that a dome can be placed on it without difficulty or apparent abruptness. But besides gaining this floor for the dome, several other points have to be attended to, and the first is, that externally the dome should spring from within the line of the walls; internally, the same line should be carried up, but externally such an arrangement would be weak in the extreme. In small buildings this is easily got over; a wall 6 feet thick allows a dome 3 feet thick to be placed 3 feet from its face; and by thickening the wall another foot or two, the required apparent stability is obtained. In larger buildings this is generally effected by an outer verandah, or range of apartments, which, added to the internal square, gives the requisite base to the dome.

At Beejapore, however, and in domes of such size, neither of these expedients was available. It would have required walls 15 to 20 feet thick had the first, and an enormous increase of height, had the second expedient been employed, or the building would have appeared squat and ill proportioned. The architects therefore adopted the plan exemplified in the drawings which I will call, if you please, the Beejapore Pendentive, which consists in carrying the Roman arch not from one point of the octagon to the one nearest it, but to the next: by this means a much more extended floor is obtained for the dome, and though of the same thickness as the walls, it can be brought as far within their line as appearances require. A second advantage of this construction is that the architect obtains a mass of masonry so much larger than the whole mass of the dome, that no motion or disturbance of its equilibrium can affect the support on which it stands, and consequently if there be not some most glaring inherent defect in the dome itself, it would stand for ever. A third

advantage is that the mass is so placed that its tendency is to fall inwards, or in other words, to draw the building together. This is easily and surely counteracted by the arch form of the circle; but at all events outward motion is impossible, and that is the one thing to be avoided in the present instance. A fourth advantage gained by this construction is the great gallery which surrounds the base of the dome, nearly 13 feet in width, which is not only a noble feature in itself to a person walking upon it, but when seen from below, has all the effect of the boldest cornice in the world—which it is—and conceals the springing of the dome from every point, so that it seems like a vast vault of unlimited extent spanning the whole space below with a simple grandeur, which, so far as I know, is unrivalled in any part of the world.

On the last occasion several parties objected to the construction of the dome as unscientific, and had the discussion taken place at the Institute of Civil Engineers, the issue should have been taken on that point. Here, we ought rather to ask, is it artistic; according to India notions, it certainly is, and so I think all will agree who see how exquisitely proportionate it is to the mass it covers, how solid, and, if I may so express it, solemn its outline is, and consequently how appropriate for a tomb. That it is unscientific according to our European notions I willingly admit, as it is thinnest at the springing, where it is 9 feet 6; a little above this it is 10 feet 6, and carries a thickness of rather more than 10 feet to the apex, where it is 18 feet; a mode of construction exactly the reverse of ours, and perhaps of what it should be, if the question was only how the place could be roofed with the least possible number of bricks. That its science is sufficient is proved by the fact that it has stood two centuries uninjured, indeed, barring earthquakes and pepul trees* it would with moderate care stand for ever.

The fact is the Indians knew so well the capabilities of domes that they could play with them, and have no fear of their falling; we in Europe are afraid of them, and have never fairly tested their capabilities.

Sir Christopher Wren shirked the question entirely by introducing a cone, constructively no doubt the best form for his purpose — artistically the worst, as he confessed by hiding it both internally and externally.

Brunelleschi halved the difference, adopting a form slightly curved externally. The octagonal form of his plan rendered this tolerable, though not beautiful; for a circular dome it would be unbearable.

Michael Angelo did better, and produced a bolder construction and a far more artistic form, and had he been able to secure his base constructively, without iron ties, his dome might have been eternal. Had either he or Wren known for instance of this Beejapore mode of placing a mass at the springing, sufficient by its inertia to resist any movement in the vault, and to convert all outward thrust into inward pressure, they might have constructed far larger domes far more solidly than they have done. I trust the subject may excite some interest, for I feel, so far at least as my own personal convictions are concerned, that the dome is by far the noblest feature which man has conquered from nature, for building purposes. Externally its grandeur far exceeds that of Gothic steeples or towers, or any other form we are acquainted with. Internally it covers larger spaces than any other form of permanent roof, and in its simple sublimity far surpasses all the elaborate littlenesses of Gothic vaultings. It is also a true roof, which no Gothic vault is, the latter being merely a sham ceiling under a wooden roof, like the dome of St. Pauls; but when its con-

* Pepul trees (*ficus religiosa*) are the great enemies of buildings in India. They grow *par préférence* on brickwork, and if once they get their roots into a crevice, they split the strongest wall in a very few years, and tear domes especially to pieces. J. F.

struction is understood, a domo requires no such covering, but ornaments the building it surmounts both externally and internally. It is also, I am convinced, the easiest constructed of all true roofs; and whether it is thin as the domo of earthen pots of San Vitale, or constructive as that of the Pantheon, or bold as that of the tomb of Muhammed, it stands with ease and lasts through ages, and with our science may be made as eternal as the pyramids.

Before sitting down I may allude to one other dome, that of Sta Sophia at Constantinople, of which at last some authentic particulars have been obtained in the work of Salzenberg of Berlin, who, taking advantage of the scaffoldings erected by Fossati for the repair of the building, measured carefully every part of it, and has just published the result of his researches in one of the most beautiful works produced for a long time, from which the section on the wall is copied. From this it appears that the diameter of the drum of the dome is 100 Prussian feet, or 102 feet 11 inches English, but the dome itself is 4 feet more, or 107 feet in diameter. It is constructed of forty ribs, projecting each 2 feet, which die away towards the centre, leaving about one-third of the dome perfectly plain. The form is segmental, 45 feet 6 in height, and described consequently from a point about 8 feet below the springing. Round the base are forty windows, which throw in a flood of light; and altogether its appearance internally is as beautiful as any I know of. Originally it was even flatter than it now is, but being in that form beyond the constructive power of its architect, it fell in, and the present form was adopted; but even then the architect tried to keep it as low as possible, judging correctly, that the flatter it was the greater would be its apparent size, and also that of the floor it covered, and of all the parts around it. To obtain these internal advantages however, the architect sacrificed the exterior entirely, and it is on the outside perhaps the ugliest dome ever constructed. But the same remark applies to the whole church. No pains whatever seems to have been taken with the exterior, though every part of the interior is designed with the greatest care, and ornamented with the most profuse liberality.

These correct details being added to our previous small stock of knowledge regarding Sta Sophia, must be considered an immense gain to architectural science, and connected with what we know of the dome at Beejapore, will open, I trust, a new era in the science of dome building.

In reply to questions, Mr. Fergusson again stated that the dome at Beejapore was constructed of brickwork without centering, that the courses of the pendentives were not horizontal, but radiating, and that the mortar was made of the common lime of the country, which was very good. In India such buildings as the tomb of Muhammed probably took twenty years in their construction, out of which not less than three or four years would have been occupied on the dome.

The Honorary Secretary read a communication from Mr. Penrose, V.P., to the following effect: It will be seen, in the section I send of Metz Cathedral, that the wall above the vault overhangs to some extent, and also (as in all the old vaultings which I have examined) that the courses are carried up horizontally to a considerable height, thus corbelling out to meet the thrust, and opposing to the outward pressure of the vault a tendency in the wall to fall inwards. The rough diagram on the opposite side will explain my meaning better. 1st. Considering the wall by itself. The tendency of the overhanging mass is to fall forwards in a direction contrary to the thrust of the vault. 2nd. And considering the vault by itself. As practically there is seldom any chance of the voussoirs sliding upon one another, the horizontal pressure at the crown of the vault acts by means of a continuous lever about the fulcrum, at the lowest radiating joint. Had the radiating joints extended to the springing, this fulcrum would have been at the springing, and not only would the thrust of the vault been greater, but the advantage of the counteracting pressure already referred to would have been lost.

The advantage obtained in the construction of the Indian vault is an interesting variety, but the

same in principle. The fulcrum of the great dome is at its base inside, and the inward tendency of the great corbel, which is formed below the great arch, instead of above it, as in Metz Cathedral, opposes itself to the outward thrust. I think that the curious arrangement of the arches which seem to support this great corbel, as I have called it, is meant to amuse the eye, and has very little to do with the question of equilibrium. It does not appear to me that the great dome itself is worthy of much commendation, except it be that a great thickness of material is useful to exclude the heat, but which a hollow construction, which such an architect as Brunelleschi would have advised, would have done much more efficiently. I think that while we admire the happy arrangement of the lower part, we cannot call the whole construction scientific, which would imply that thought had been well bestowed on every part.

Mr. Papworth, Fellow, stated, that as to the principles of the construction of the great Mosque in question, he would preface his two chief points of consideration by saying, that he believed there was no one present capable of pointing out any published work on domes which had any authority whatever, and that, therefore, if his views were mistaken, they must be imputed to unintentional ignorance: at all events, he would make the assertions that a dome was not an arch, and that domes were not governed by the same laws as vaults; at least that was what he meant to lay before the meeting for its examination and investigation. He reserved the right of allowing certain exceptions, into which he should not then enter, but be satisfied with calling the attention of the meeting to the question of the scientific construction of the dome and its pendentives.

He would begin his own remarks with the pendentives. It seemed that A B C D being a square (say of 100 feet), and E F G H the diameters, F G deducted from A D giving the point K, and the points L M N O P Q R being similarly found, then the common pendentives in K L, &c. were more scientific and practically useful than the pendentive of the Gol Goomuz formed on the intersecting lines P K, K M, O K, L, &c.; for the wall, if 7 feet thick, which was about the proportion to 100 feet adopted at the Gol Goomuz, would in the case of K L give a pier for thrust 49 square feet in area at K and L; but in the case of K P, 119 square feet at P, and 21 square feet at K. The lengths of K L would be 64 feet, and of K P 86 feet; therefore half the arch on K L, equal in base to 32 feet, would thrust on a pier of 49 square feet in base, while half the arch on L N, equal in base to 43 feet, would thrust on a pier of 119 square feet in base, while the other half, or 43 feet, would thrust against a pier of 21 square feet in base; and he would assume as a rule in building that equal thrusts came best on equal piers, if economy in materials was to be considered a merit. He hoped for an explanation of the peculiar merit supposed to be displayed by the principle of the pendentives which had been described as adopted in the Gol Goomuz.

Mr. Fergusson replied, referring to the drawings and making explanatory sketches on the board, if you had to choose between *this* arch K L, and *that* K T, it would be so; but *this* pier L, does not only resist the thrust of *this* arch M L, but of the arch L N coming from *here* (referring to sketch). There are arches abutting upon every pier. There is a pier *here* L, which cuts the thrust to A *so* (sketching), and *this* pier A, has to support *this* O K, *that* N L, and the others P K and M L. All these thrusts are crossing one another. It is in the complication of these arches and of the vaults, of which the arches referred to by Mr. Papworth are only the outline, that the stability of the structure has been acquired.

Mr. Papworth still considered the explanation unsatisfactory, as the pier L had to receive the thrust of half that arch K L, and also of the portion of the dome which would rest upon it, &c.; but in the Gol Goomuz instance each two portions of wall, N and L, took their own portion of the thrusts from the arch L N, and each half of that arch seemed to have an additional weight thrown upon it at

each intersection, besides the fair share of the weight of the dome which would rest upon it, &c.; it therefore was still more desirable that the piers K and L should be as nearly equally solid (being necessarily in opposed walls) as possible, and if L was strong enough for K L, P was far too strong for K P, or if P was only strong enough for K P, the pier L was far to weak for K L.

Mr. Fergusson—If a certain mass has to be supported inside this building on arches, it must rest somewhere. The question is, where is it best that it should rest; at these points A B C D in the wall, or at an angle of 45°, as K L M P N Q R O.

Mr. C. Fowler, Associate, said it appeared to him that in the construction in question there were two forces acting in a certain direction upon a certain point, and the result of those two forces, supposing them to be equal, must be such as to produce a force very nearly, if not directly, at right angles to the wall. He would also ask whether the wall was thick enough to allow the two forces to be resolved within it, and whether the corbelling was so constructed as to allow the dome to be within the external wall.

Mr. Fergusson.—It is a complication of arches.

Mr. C. Fowler thought too much stress had been laid upon the effect of the towers at the angles, as buttresses.

Mr. Fergusson.—The great mass of the body is in the angles.

Mr. Tarring, Fellow, made some observations on the question of construction with respect to the pendentives.

Mr. Fergusson.—There is a complication of thrusts, which assist one another.

Mr. Papworth expressed himself perfectly satisfied, as all the gentlemen who had spoken appeared to coincide in his views. Mr. Fowler's remarks had embodied points on the resolution of forces which he himself had not intended to open, as there was some difficulty in going into such questions in a mixed meeting. Mr. Papworth then entered into calculations on the causes of the stability of domes, showing that in domes of equal thickness the upper half of each gore was only one-third in weight of the lower half, and adduced the possibility of loading the crown to a certain extent; producing a series of drawings of domes, constructed upon principles which ought theoretically, if they were arches, to lead to their failure, but which had nevertheless proved perfectly sound; his views being fortified by Mr. Fergusson's concurrence as to the absence of examples of failure where the bases were stable. He then alluded, with his reasons for non-concurrence, to suggestions that the dome of the Pantheon at Rome had been built on the principle of a bridge, *i. e.* of an arch; that it was impossible to plan a large dome without great thickness of walls, *i. e.* greater than sufficient to bear the weight and its consequences; that it was necessary for the exterior of a dome to stand flush with the wall of the building to which it belonged; that it was desirable to append heavy corbelling to the inside of the wall to counteract the thrust of a dome, with special reference to some circular tambours, of which he exhibited sketches; to the supposed unnecessarily great weight on the top of some examples; and to the supposed beauty of principle exhibited in the dome of Sta. Maria, at Florence, which he characterized as a piece of octagonal vaulting, and not a dome. He also explained that domes which had failed had not been supported on a stable foundation; that he saw great beauty in the idea of forming an eye in so large a dome as that of the Gol Goomuz, where the centre of the curve on each side of the section was in the edge of the eye; that the outer face of the springing of a dome might be within the inside of the square enclosing wall of the building; that if the principles of vaulting were applied, the waggon-headed section of the Gol Goomuz dome would not be expected, theoretically, to stand; and concluded by some observations in explanation of his illustrations, as to the requisite thickness of domes. His observations on these points were of considerable length, and excited much interest; but it is impossible to report them accurately without reference to the drawings.

Mr. Mathews, Associate, made some remarks in the belief that authors upon vaulting had considered the case of domical vaulting specially without reference to arches, and wished to impress on the meeting that their theories should be considered as formularized experiments ready for practical adoption.

Mr. Papworth observed, that the writers on arches had all, so far as he had seen, considered the dome as a case of vaulting on principles deduced from their experiments on arches, which was a mode repudiated by him; that the present theory of arches was so far from being practical, that it eliminated the question of cohesion in the materials; and that he would be glad to receive statements on that point which would assist his further investigation of the question of domical vaulting, before laying his views, in a collected form, open to public criticism.

Mr. Hesketh, Fellow, thought the dome in question was constructed partly by a system of corbelling, as any tendency to thrust with concentric rings might have been got over by constructing a portion of the lower part by such a system. The dome was probably constructed so as to have no lateral thrust whatever. It required only a vertical support; and the support it derived from the arches was real, as Mr. Fergusson had explained. He thought the great external projecting cornice had been made use of in carrying the thrust of the arches from their haunches to the four angular towers, which, it appeared to him, were so placed in order to receive it, and could not be intended for any other purpose. (Mr. Hesketh referred in illustration to the drawings and the sketches on the board).

Mr. Jennings, Fellow, observed that the question now under discussion was how the building had been so admirably constructed; but a preliminary question should be, whether it was really constructed on scientific principles or not. The thickness of the dome (10 feet) itself proved a want of scientific knowledge, and it did not appear to him that the form was the best that could have been chosen. The consideration of the pendentives was interesting, as affecting the question of the direction and resolution of forces. He could not see that the weight of the dome had increased the strength of the building, or that the thrust had been carried into the angular towers.

Mr. Fergusson said, that from its thickness the dome was certainly unscientific, and that, as an engineering point, it failed. It was an artistic and not an engineering dome. No contractor or engineer would propose now to construct a dome in the same way; but when a Mahomedan king was constructing his own tomb, he did not care for a million of bricks; the only point was to realize the artistic effect which was thought necessary. Whatever was the abstract power of the arches, it came across the great mass in the angles, which was immoveable, and could not be affected by any of the thrusts. In an artistic point of view it was one of the best domes ever constructed; but of course, if it had to be erected now, it could be done with half the materials.

Mr. Hesketh.—It would not resist a cannon ball.

Mr. Fergusson.—It would resist an earthquake.

Mr Scoles, H.S., referred to the section of a dome built under his direction in the year 1841. The span was 30 feet, the supporting walls 3 bricks thick, the springing line 36 feet from the floor. For the height of 3 feet above the springing the dome was formed by courses of bricks corbelled over; above that it was composed of four courses of plain tiles set in cement—in all $4\frac{1}{2}$ inches in thickness. The construction had fully answered his expectations.

The Chairman, Mr. T. H. Wyatt, V.P., intimated that it was necessary to bring the discussion to a close. Mr. Fergusson did not insist that the great Mosque at Beejapore was a very scientific structure, and this was the point to which Mr. Papworth had called their attention. The thanks of the meeting were due to both gentlemen, and he (the Chairman) hoped that Mr. Papworth would be able to apply to a further purpose the interesting diagrams which he had submitted to the meeting.

The meeting then adjourned to January 8th, 1855.

ON THE SPIRE OF ALL SAINTS' CHURCH, CHESTERFIELD.

By W. G. Coldwell, Associate.

Read at the Ordinary General Meeting of the Royal Institute of British Architects, January 8, 1855.

There are but few objects in this country that have excited more curiosity than the Spire of Chesterfield Parish Church. Its situation in the Midland Counties, near one of the principal railways, and adjoining that part of Derbyshire which is so much frequented by tourists, renders it much more familiar than many structures of greater architectural worth. Whoever sees it cannot but be struck with its peculiar outline, and curiosity is increased when on enquiring the cause one fails to receive a satisfactory answer. A local rhymer says :—

Whichever way you turn your eye
It always seems to be awry,
Pray can you tell the reason why?
The only reason known of weight,
Is that the thing was never straight.

This is one account concerning this spire, that has in the neighbourhood numerous supporters. Many firmly believe it was built crooked as we now see it. But there is another version far more singular, and which is, I think, more generally entertained, that is, that the spire is not crooked, but is perfectly upright and perpendicular. When in Chesterfield last summer, in a position about the best for observing the inclination of this spire, I enquired why it was crooked from a gentleman whose age and intelligence I thought would assist me in this investigation. To my surprise, he in the most positive manner, assured me it was "quite straight." He declined giving a reason why it appeared otherwise, and I could only regret that any one should make such bad use of his eye-sight. Within the last month I have had frequent proofs of the belief out of Chesterfield that this spire is straight, and strange to say, I find it even in print, with a reason assigned for its appearing otherwise. In Lewis's Topographical Dictionary we have a description of Chesterfield Church Tower being "surmounted by a lofty spire, which, from the peculiar mode of putting on the lead with which it is covered, though perfectly upright, appears in every direction in which it is viewed to incline considerably from the perpendicular." This version I have heard in the neighbourhood, with the addition as a conclusive argument, that if you walk round the spire it will always appear to lean in the same direction. The outlines on the walls sufficiently prove how far this oft-told story will bear examination. Any one here who has never visited Chesterfield, must feel astonished that such a tale could have obtained the circulation it undoubtedly has. The only reason I can assign is, that it has arisen from a natural love of the marvellous, and a desire to have here a wonder as great as any in the neighbouring wonderful district of the Peak.

I have endeavoured to ascertain the date of the erection of this spire, and also the earliest indication of its deflexion, but without any satisfactory result. Neither Leland, Stukely, nor Gough assists me. A writer in "The Beauties of England and Wales," says, "This church appears to have been dedicated in the year 1232;" but there is no particular allusion to the spire. In a work entitled "A Tour through Great Britain," published in 1753, there is the following concerning Chesterfield: "It has a fair church. The spire of its steeple being timber, covered with lead, is warped all awry." This gives us evidence of the existence of this inclination for upwards of a hundred years.

Having a thirty years' recollection of this place, and having heard these and other extraordinary tales concerning it when they had their full influence, I may be excused for admitting

that previous to examining its framing, I thought it possible that there might be some foundation for the local belief that it was built crooked. I thought it just possible that the builder might have endeavoured to construct it in such way that the rolls at the angles, instead of being perpendicular, should twist slightly round, similar to what we occasionally find on the Continent, in stone pinnacles of the Flamboyant period, but the first glance internally was sufficient to eradicate such an idea, and I was obliged to discard this, the last remnant of early impressions, as having not the slightest foundation. The rafters are tenoned into a sill, and as these tenons are cut at right angles to the direction of their length, it follows that to have a proper bearing each rafter must be perpendicular, therefore this brings the definite conclusion, that the spire when built was built upright.

I hope it will not be considered I have occupied too much time with a matter that may appear of little importance. I should not have said so much, had not local prejudice been so strong, that this Paper might be considered incomplete if I had not alluded to it.

Internally this spire presents the strangest assemblage of timbers that can be conceived. The great deflexion from the perpendicular amounting to about seven feet, the twisting round of the upper part, which amounts at the apex to about 60o, the timbers which have been added when it was repaired, all these combined with the want of light, produce such a constructive Babel that I much question if its equal can elsewhere be found. On closely examining it, however, we are enabled to discriminate without much difficulty between what is old and what is of more recent date. The original construction is entirely of oak, while deal has been used in the repairs, and again the old work is morticed together and fastened with oak pins, and the new is secured with iron bolts and straps. With these particulars as guides, I have made out from measurements taken in September before last a section which shows all the timbers that remain of the original construction. It may be described as follows: Upon the tower walls, which are here 3′ · 6″ in thickness, rest four tie beams, each being of the scantling of 18″×9″; two of these rest on the north and south sides, and the other two are placed in the opposite direction, at right angles to the first, and notched on the top of them. At their intersection are four upright posts, 14″×9″ at the base, slightly converging inwards, which form as it were the posts of two queen trusses, and have struts, or principal rafters, 11″×6″, on all the eight sides. These posts are tenoned at the bottom into the upper tie beams, and at the height of about 18′: 0″ are tenoned into the under side of a second set of tie beams. These second tie beams of the scantling of 15″×9′, have others crossing them at right angles, notched on the top of them, similar to those first mentioned. Posts 8″×8″ are tenoned into these, and these posts, at the height of about 17′: 0″, are again tenoned into the under side of a third set of tie beams, which are of the scantling of 12″×11″. The same construction is repeated, and at an additional height of about 16′: 0″ we have the inner upright timbers, or queen posts, tenoned into the under side of a fourth set of tie beams, 9″×7″. From the upper side of these last the four inner posts of diminished scantling rise uninterruptedly as far as the construction can be seen, or to what is called the "crow hole." At the level of each of these tie beams are struts, or principal rafters, also between the posts are diagonal beams, all halved and pinned together, and also a small scantling of timber placed horizontally, tenoned into the four sides of the upright posts. All these are shewn on the section with their respective scantlings figured. The ends of the tie beams are secured to angle or hip rafters, which at the base are of the scantling of 8″× 6″, and diminish to 5″×5″ at the top. The construction of this spire above the upper or fourth set of tie beams need not, I think, be particularly alluded to, the drawing shews it better than I can describe it; and, moreover, there has been no displacement in the timbers of this part but what can be attributed to causes below it. There are but few purlins to be found, those that exist are for the most part near the top, where, as I have just now observed, there has been but little change of form. We may

conclude from their occurring below at irregular intervals that they have been more numerous. The rafters are of the average scantling of $4'' \times 3\frac{1}{2}''$; they are tenoned at the bottom into a sill, $15'' \times 6''$, at the level of the lower tie beams. At the base of the spire, tenoned into a lower sill, are rafters opposite the outer ones, as shewn on the section. The rafters are covered with stout oak boarding, laid horizontally, and upon this the lead rolls are fixed in the manner shewn in the elevations.

Whether between the year 1753, when, as we have already observed, this deflexion was noticed, and the beginning of the present century any examination was made we have no evidence to shew, but it appears that in the year 1817 great uneasiness was manifested in the town, and as danger was apprehended, several competent persons were appointed to examine this spire, and report upon its condition.

A local history to which I am indebted for some of my information, gives these reports in full but as they are lengthy, I will only read an abbreviation of them. The first is as follows :—

" We, whose names are hereunto subscribed, did on the 26th November, 1817, carefully examine the state of the wood in the steeple of Chesterfield Church, and find it not only in a very decayed state in some parts, but the greatest part of the principal timbers having a tendency to push the steeple towards the south, the top of which is now very far from being perpendicular over its base, which renders it necessary to prevent the top part of the steeple going further southward. If it be suffered to remain unsupported a few years, it will certainly become in a dangerous state, and it is very probable that it will fail at about the middle of the steeple, and fall towards the south or south west.

(Signed) " D. Hodkin.

" B. Tomlinson."

Another report is by W. Wilkinson, dated December 19, 1817. He says—" The timbers on the south, south west, and west sides, are very decayed. The rafters are out of the perpendicular as much as 1 foot in 6 on one side, and several of them about as much the other way. All are discontinued and broken, and consequently the perpendicular is destroyed. The general principles of its construction, as a piece of carpenter's work, is very bad and injudicious, and such as would disgrace the most inexperienced carpenter of the present age; but (he adds) I have observed this to be the case in most spires of ancient carpenter's work I have examined in different parts of the kingdom. The timbers are decayed ;—it was originally built square. All spires are soon out of repair on the south, south west, and west sides." And he concludes by recommending the spire to be taken down.

E. W. Drury, December 20th, 1817, reports the spire unsafe and dangerous, the timbers decayed, the construction imperfect, and he recommends it to be taken down.

James Ward, of Sheffield, reports that he professionally examined it on the 24th January, 1818. It could be made to stand, with a little repair, for a century or more upon its present construction. There was no probability of its falling so long as the pillars upon which it stood were strong enough to bear or support its weight. With respect to dry rot, which was said to have affected the timber, he observed that there was no reason for apprehension on that score, as the wood was perfectly sound. He further stated that the foundation or base of the carpenter's work was firm and good, which rendered it nearly impossible that it should ever fall until the base itself gave way. He observed, lastly, concerning the steeple, which was strapped and well fitted together, that it was impossible it should ever fall if the necessary repairs were occasionally made in the wood work, because the base was firm and good, adding that there was not the slightest leaving from the shoulders, tenons, dovetails, or any other parts whatever, which convinced him that the steeple had never given way in the least since the day it was first erected, or it would have fallen down instantaneously. This report was corroborated by Joseph Ball, Francis Rogers, and George Bond.

It will be observed that none of these reports give any amount of the deflexion, but this omission we have supplied by the Rev. George Hall, who during his curacy of this church wrote a history of it. He says—" By measurement in January 1818, the ball on which the weathercock is fixed was found to lean towards the south 6′ : 0″ from the perpendicular of its base, and 4′ : 4″ out of its perpendicular towards the west, which gives a deflexion nearly south west of 7′ : 5″.

The reports just read gave rise to considerable debate at public meetings, which were held to consider them. Some wished the spire to be taken down, and some that it should remain ; eventually it was determined to have it repaired as advised in the last report, and to these repairs I wish now to direct your attention, as their nature in connection with the present condition of the spire will enable us to examine the failure in its construction, and to investigate its cause. It will be observed in all these reports the spire only is alluded to. I examined carefully the tower, but was unable to detect the slightest indication of settlement; all the failure is in the spire alone.

It would be tedious to detail all the work which appears to have been at that time done; it will be sufficient to state that in addition to trifling repairs throughout, the bulk of the work was local, and consisted in stiffening and rendering stable, by what a ship carpenter calls fishing, one of the four series of upright posts which form the inner trussing of the spire, viz. that towards the south west. In some parts the original timber is completely cased up with the new, so that it cannot be seen. Some of the tie beams adjoining and in connection with them are also fished. For additional security a sill has been carried across the south west angle of the tower, and supports, in the manner shewn on the plan, two upright beams of the scantling, of $9\frac{1}{2}'' \times 9\frac{1}{2}''$, which are framed into a cross head near the uppermost tie beam, and in addition to having several struts are secured to whatever old timbers they come near. In one instance a tie beam has been cut away for the passage of one of these, and substituted by two half timbers, one on each side, and all are bolted firmly together. Struts or braces have been introduced on the inner face of the rafters in several stages opposed to the direction of the settlement. Queen trusses have been fixed under the lower tie beams, and a great number of other timbers have been introduced, for which it is difficult to assign a use.

It will be seen from these repairs, that, although Mr. James Ward, and those who signed the report with him, asserted there was no decay of importance, yet the first report was the more correct one. The timbers now on the sides towards the south, west, and south-west, are very much decayed, but be it remarked, that, although there are places where decay spreads over a large surface, it is more particularly at the joints of the framing. It is questionable if this decay alone would account for the great deflexion without a displacement of some of the timbers, and this, I am disposed to think, has taken place previous to the repairs, for among other information, the history of the neighbourhood gives us is the following—that Mr. Matthias Wilson, a cabinet maker, made a model of this spire, and said, "that one of the four upright beams being drawn out of its tenon had shrunk several inches, and this had caused the spire to have its singular leaning appearance." That the spire is so much more decayed in one part than another, and on the weather side, can easily be attributed to the frequent presence of moisture and quick evaporation. Possibly the leadwork near the top of the spire was unsound, and the rain being admitted caused the decay which has been mentioned; and from the cabinet maker's statement, it is possible that this decay may have been so great in one of the tie beams that it failed to retain the tenon of the upright post in its proper position. The manner in which the spire was built, with a number of joints one over the other, all forming receptacles for moisture, and hence for decay, hastened the result; and it can easily be imagined how through the shortening as it were of one of these columns, even without one of the timbers breaking

away out of its mortice hole, the great weight above would descend, completely dislocate all trifling impediments, and have a tendency to fail as this spire has done, by going obliquely downwards and sideways, twisting every thing in any way pliable, and as all timbers were tenoned and pinned, they would not offer such a resistance as would counteract the great descending weight.

It would take up too much time to examine all the theories that have been promulgated; one has attributed it to the wood being warped through the action of the sun; another considered the weight of the lead had caused it; damage by lightning has been suggested, and to illustrate this an example was quoted of a stone spire at Linthwaite, near Huddersfield, being crippled through lightning; and the local history again tells us "an architect of some eminence had it plumbed and found it perfectly straight."

There is now but one subject I would mention, and that is my impression that the spire has settled, though in a trifling degree, since the repairs. I am led to this conclusion, first from the manner in which the old work in places appears to bind on to the new upright posts that have been introduced; secondly, from the great strain one of these new timbers appears to have, the camber being so great, that I believe the versed sine of the arc it forms in a length of thirty feet is upwards of two feet; and thirdly, from one of the diagonal braces being sprung, and the notches at its back to receive the rafters being an inch or two away from the rafters themselves.

In conclusion, I would observe that I do not wish it to be understood that this spire is unsafe; all I have wished to do is to lay before this Institute as correct an account of it as I have been able to put together with all its several peculiarities, so as to enable those gentlemen who have not seen it, to form an opinion for themselves, not only respecting its original construction and settlement, but also on the cause of such settlement and its present condition. That the stability of its original construction is gone I think must be admitted, and that it is upheld only by the timbers subsequently added. As to the sufficiency of these to sustain the imposed weight, personal examination alone can determine. On the first glance every one would condemn the spire as being really dangerous, but on a minute and careful examination, although the doubt as to the ultimate fall might not be removed, still the fear of immediate danger might be allayed. I hope what has been brought forward will be an additional proof of the old architectural axiom that the best constructive lesson is a failure.

Mr. Coldwell further stated, that the height of the spire itself without the tower, was 111 ft., the tower being a square of 23 ft. 10 in. inside, and the walls 3 ft. 6 in. thick. He believed the remarkable twist in the spire was caused by the shortening of the timbers of one of the series of upright posts, by which the whole superincumbent weight had been brought down.

Mr. Donaldson, H.S.F.C., observed that, as a general rule, timber would not shrink in length, and therefore there must have been some decay to account for the supposed shortening of the upright posts.

Mr. Coldwell explained that the ends of the timbers had decayed in one particular series of uprights more than in the others, and consequently the spire had settled downwards, obliquely and sideways. It was extremely difficult to ascertain the cause of the failure, as he could only measure in the dark with a two-foot rule, but he believed it to have arisen entirely from the decay of the timbers on one side only.

Mr. Donaldson remarked that the construction of the spire resembled the scaffoldings now used in buildings, being a series of vertical stages. He also alluded to a water tower at Buckingham, engraved in Nicholson's Carpentry, as illustrative of the question before the meeting.

Mr. Heneker, Associate, considered that originally the four posts or legs were all equal, and then the spire stood upright; but as soon as one became shortened, the others, not being compressible, twisted themselves, in order to correspond to it; but their not being able to do this sufficiently had given them a fall in one direction.

Mr. Pooock, Fellow, observed, as a singular feature, that the spire leaned towards, and not from, the quarter from which the prevailing wind in England blows.

Mr. P. C. Hardwick, Fellow, considered the admission of rain through a defect in the lead causing decay in the joints of the framing, was a very natural way of accounting for the failure of this spire.

Mr. Baker, Associate, inquired if there were any horizontal or wind braces in the spire.

The Chairman suggested that it would be advantageous if Mr. Coldwell could, at a future meeting, produce a larger drawing of the construction, in order that the subject might be more fully investigated.

Mr. Alexander, Fellow, concurred. It would be very desirable to shew the exact levels of the horizontal timbers all the way up, in order to ascertain whether the failure had occurred at the top, the middle, or the bottom.

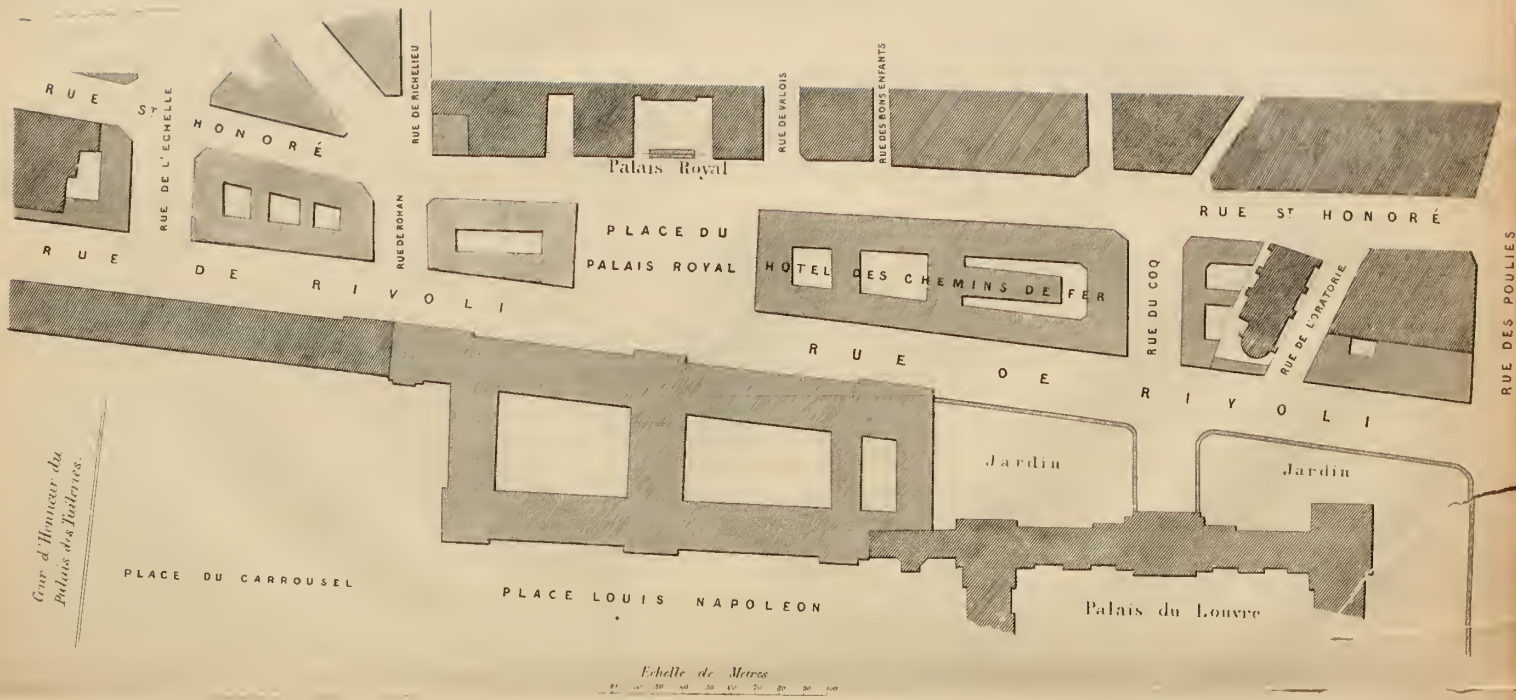
Mr. Hesketh, Fellow, inquired whether there were any really good solid timbers in the hips, at the angles, which would help to support the spire.

Mr. Coldwell stated that there were timbers, nearly square, of $8'' \times 6$ at the bottom, diminishing to $5'' \times 5''$ at the top, in continuous lengths, abutting one against another. With regard to the horizontal timbers, they were out of level at every stage, but to what extent he had not been able to ascertain. He had not found any indications of old wind braces; though there were some which appeared to be insertions of deal of a later date.

Mr. Hesketh suggested that if at one stage one of the upright posts had sunk, either by the sagging of the tie beams or from decay, that would not in itself produce a twist, but it would occasion the spire to lean. If however in the next stage the same thing occurred at another angle, and in a higher stage at a third angle, and so on, he believed exactly the twist which now existed would be produced.

Mr. Coldwell said he should be happy to produce larger drawings at a future meeting. He believed the greatest amount of failure had been in the third tie beam from the bottom, where probably one of the posts had slipped out of the mortice, through decay. The timbers on the south-west side were decayed all the way down, particularly in the tenons and mortices; and he considered that the leaning and twisting of the spire was the natural result of their failure.

The Meeting then adjourned to the 22nd of January.



The Light Tint denotes Buildings in course of construction

PLACE DE L'ETOILE

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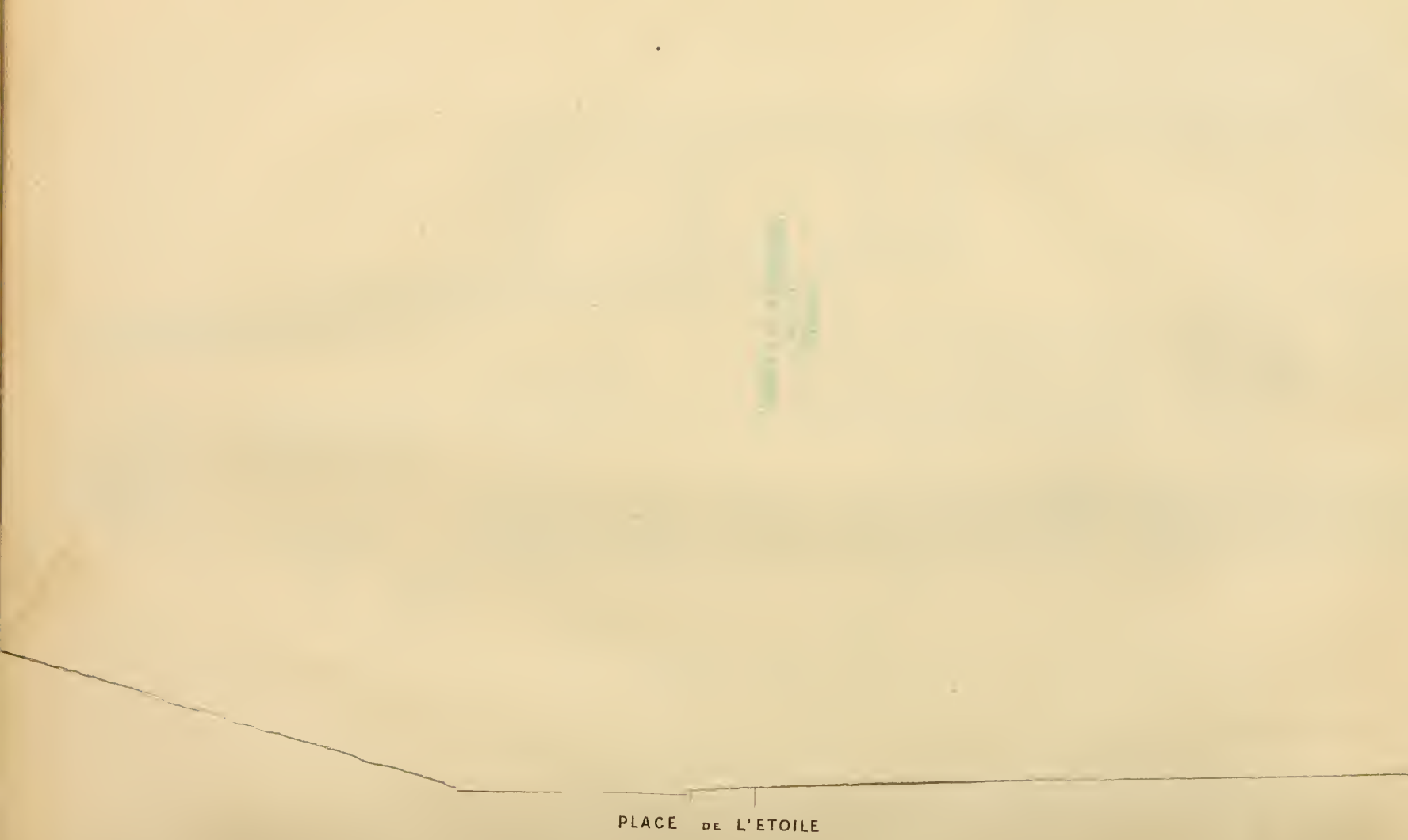

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A DESCRIPTION OF SOME OF THE CONSTRUCTIONS NOW IN COURSE OF EXECUTION BETWEEN THE LOUVRE AND THE PALAIS-ROYAL AT PARIS.

By T. L. Donaldson, Fellow, Hon. Sec. of Foreign Correspondence.

Given at the Ordinary General Meeting of the Royal Institute of British Architects, January 22, 1855.

The works now carried on at Paris under the direction of the Emperor constitute one of the most remarkable features of modern times: indeed I cannot recall to mind any period since the time of the Roman Emperors when works of such magnitude, magnificence, and essential utility were executed at once. It is not mere flattery to say, that, in all these public improvements he is the great ruling genius; everything originates with him, and the opinions of all the other authorities are subordinate to his decision, which is carried out, because it is supported by a well understood and very firm will. Many present have of course seen the continuation of the Rue de Rivoli, lately opened in connection with the buildings at the Louvre, which I described to a Meeting of this Institute at the beginning of last year. Having visited these works recently, I have thought it might be interesting to the members, if I were to communicate briefly some of the observations, which I made on the occasion.

Our Honorary and Corresponding Member, M. Hittorff, was so kind as to show me the lithographed contract drawings for the works, prepared by himself and his colleagues, and he has, with their sanction, very kindly contributed the copy on the table to this Institute. As they are drawn to the scale of $\frac{1}{50}$th, or very nearly $\frac{1}{4}$ inch to the foot, they are sufficiently large to enable us to understand and appreciate all the details. On the general plan of the locality are indicated the portion of the Louvre erected by Napoleon I. and Louis XVIII, and the new continuation, together with the garden beyond it, next the Colonnade of Perrault. It will be seen that the Rue de Rivoli has been greatly widened by the removal of a number of mis-shapen houses, narrow streets, and inconvenient thoroughfares. It has been supposed in this country that such alterations and improvements are effected at a much cheaper rate in Paris than in London; but the truth is, that on the contrary they are, if possible, more expensive in that city, and for this reason, that if an amicable arrangement for the purchase of the property required cannot be made, the promoters have not only to go before a jury, and buy up the ground-rents, the intermediate interests, and all the good-wills, as with us, but also to buy out the occupants of all the floors up to the very top; consequently there are numerous interests to combat, and compensation must be given to all the various parties carrying on their separate trades in the different stories. It is seldom in London that we have to treat with lodgers, who have such specific trade interests. Therefore, although the value of ground in Paris is not to be estimated at such a rate as £400,000. an acre, as it is for some plots in the City of London, the price to be paid is still very high, and ground is more valuable, generally speaking, than here. However, the property in question in Paris was bought up, all the persons interested were remunerated, and many retired with very good fortunes. The space gained has been used to widen the Rue de Rivoli, and carry it on beyond the Hôtel de Ville, and also to widen the Rue St. Honoré which runs parallel with it. The new Rue de Rivoli is only 72 feet 6 inches wide, exclusive of the arcade, under which there is a broad footway. This width is hardly sufficient for a grand leading thoroughfare, but it has been restricted by unavoidable circumstances, and by the old part serving as a guide. The Rue St. Honoré has been widened from 46 feet to 65 feet 6 inches, and it thus relieves the Rue de Rivoli of a portion of the heavier traffic, which would otherwise pass through it.

In consequence of the immense space occupied by the Louvre, it is necessary for the convenience of the public, to permit the passage of carriages through the building; and to facilitate this line of communication the Emperor has determined that the Rue Richelieu shall be extended to intersect the Rue St. Honoré and the Rue de Rivoli, and widened, so that there shall be a direct and easy access, adapted for an immense thoroughfare, from the Boulevard to the Louvre. The traffic of Paris has so much increased of late years, that it is difficult for vehicles to traverse the city, and the great principle adopted has been to provide wide thoroughfares from the stations of the railways, instead of those formerly required from the Barrières. The Louvre may be considered a focus in which these communications concentrate, consequently the thoroughfares in its vicinity are left spacious enough to enable the traffic to be carried on with all requisite facility. Thus it will be seen on the plan, that opposite the Palais Royal an open space is left, called the Place du Palais Royal. The large block of building, which adjoins it on the right of the spectator, is to be called the Hôtel des Chemins de Fer, or the Hôtel du Louvre.

The total frontage of the ground opposite the Louvre is 2030 feet; 620 being occupied by Streets, and the Place du Palais Royal; and 1410 by houses; and of this length 1285 feet are devoted to the Hotel, and other erections under the direction of Monsieur Hittorff and his colleagues.

It has been said that the French are not an enterprising people, and that they are deficient in mutual commercial confidence. We know, however, that great sums of money were formerly hoarded by individuals, who have discovered of late, that they can apply them to realise a good interest; and a Society called *La Société Immobilière*, or Freehold Building Society, has been formed expressly to cover this ground with buildings, at a cost of about £500,000. In order to accomplish this object within six months, they thought it necessary to appoint four architects; and they selected MM. Armand, Hittorff, Rohault de Fleury, and Pelechet. A Committee of Directors, meet twice a week. The contracts are made for all the works together, and consequently the full benefit of the magnitude of the operations is gained in the price. Their intention is that the whole mass shall be built, and the Hotel finished and furnished when the Great Exhibition opens in May.

I propose to direct your attention chiefly to this Hotel, as a work of very great importance, the length being 501 feet, and the depth varying from 184 to 124 feet.

There are several entrances, so that the Hotel may be divided into two parts. No part of the ground floor, or of the entresol, except those occupied by the entrances is to be appropriated to Hotel purposes, but these portions of the plan are to be appropriated to shops, and the accommodation of the shopkeepers; therefore it is *au premier*, that the Hotel begins. [Referring to Plans.] All this part of the first floor is appropriated to Princes and Ambassadors, and other distinguished persons; and you will perceive that it comprises numerous suites of apartments, with separate staircases. Here is one grand staircase of stone, (the flight of steps 9 feet wide) with two other principal staircases to the right and left. *Here* is a place for taking in luggage, and *here* is a carriage entrance to a court about 66 feet square, which is to be covered with glass. The under part of *this portion* [referring] is for carriages in waiting—the stables being in another part; and *here* are other carriage exits into the Rue St. Honoré, and the Rue de Rivoli.

The first floor contains a grand saloon for the generality of visitors, 133 feet long by 21 feet 6 in. wide, two reception rooms, 37 ft. by 24 ft., and 33 ft. by 24 ft.; a coffee-room and dining-hall 125 ft. by 45 ft., twenty-nine large rooms about 30 feet by 20, and ninety-six smaller rooms, making a total of 125 rooms, besides the gallery, and the dining-hall for the table d'hôte; six principal, and eight secondary staircases; and above twenty water-closets; the passages are 7 ft. 6 in. and 8 ft. wide.

There is an arcade with shops under it on the sides next the Rue de Rivoli and the Place du Palais

Royal, but on the other two sides there are no arcades. There is a great deal of merit in the arrangement of the private apartments, especially as to the facility of access and egress.

On the second floor, the general arrangements are similar to those below, and there are 168 rooms of various sizes, from 13 or 14 ft. to 10 ft. wide, and from 11 ft. to 20 ft. long; these rooms are of handsome proportions, and larger than in our own ordinary hotels.

There is another story above this, which is arranged in the same way; and there are two stories in the roof. In the lower of these the walls are upright and the rooms are good, and those above are for servants. There is no division of the servants' apartments into groups, but they all communicate with one common passage.

The total height of the building, from the pavement of the street to the ridge of the roof, is 90 feet. From the level of the street to the top of the cornice, the height is 66 feet, leaving 24 feet for the roof. The heights of the different apartments are as follows;—Entrance floor, 12 ft. 2 in.; entresol, or mezzanine, 9 ft. 2 in.; first floor, 14 ft. 6 in.; second floor, 11 ft. 5 in.; third floor, 9 ft. 6 in.; two stories in the roof, each 8 ft. 6 in.; these dimensions, with about 7 ft. for the thickness of the floors, make the total height of 90 feet.

The roof plays an important part in the design, and I certainly think that a great deal of the majesty of French buildings is derived from these lofty roofs. If the roof were to be taken off the Tuileries it would reduce the building to the humble proportions of an English Palace; and if the Palace of Versailles had such a roof, it would not look, from the gardens and terraces, so mean and poor as it now does. Moreover we must bear in mind that the French do not object as we do to an extra flight or two of stairs.

With reference to the construction of this building, it may be mentioned that the basement is vaulted with arches of brick or stone, and the builder has excavated to a great depth (in some part 25 feet below the surface) to remove the old foundations. Part of it is appropriated to kitchens, and part to stores for goods. The walls in the basement are built of wrought stone at the angles and openings, to give strength and solidity, with moellon, or rubble work, in the intermediate spaces. The outer walls above the basement are all of good free stone, left rough, but to be dressed and carved hereafter. In the floors, the fire-proof construction, which is very popular in Paris, and which the Emperor wishes to be used, is adopted. It consists of I-shaped rolled iron girders from 6 to 8 in. deep, and 2 ft. apart, kept together by saddle-bars. Boards are placed beneath the girders, and the space is filled in with pieces of stone, and the excellent plaster of Paris. This concrete sets in a very few hours, and the boards are removed, the mortar being sufficiently tenacious to hold the mass together. There are long diagonal iron tie bars at the angles of the walls, to keep the whole construction compactly together.

In the upper floors, the staircases are mostly circular. In this country we generally consider such staircases as dangerous to descend, but they are not objected to in France, and they certainly economize space. The roof is of wrought iron, very light, and put together with great skill; and there are outside galleries along the upper cornice, which serve for the exercise and convenience of the occupants.

Mr. Donaldson proceeded to describe some other private houses, part of the new buildings shewn on the general plan, but distinct from the great Hotel. In illustration of these he referred, in detail, to the plans, elevations, and sections; and remarked particularly on the comparatively small number of bed-rooms connected with the principal suites of apartments.

He further called the attention of the meeting to the improvement of the Bois de Boulogne, another work of the Emperor, now almost completed; and to a project for the erection of

first-rate houses around the Arc de l'Etoile, in accordance with a design by M. Hittorff. He referred, in conclusion, to the works recently executed at the Luxembourg, and particularly to the Salle de Reception formed out of the old Salle des Conferences and two other apartments belonging to the former Chamber of Peers, which had been thrown into one magnificent Hall, 200 feet long, resplendent with marble, paintings, and gilding, in perfectly refined taste. For all this magnificence the French people were indebted to the Emperor, who was a great friend to architecture, and had judiciously given much profitable employment to the working classes, at the same time that he rendered Paris the first city in the world for the magnificence of its monuments—the ample and commodious lines of its thoroughfares and public streets—the improvement of its salubrity,—and a centre of attraction to the people of every other country,—in fact of European arts and civilization,—thus by the judicious and not parsimonious outlay of a few millions, contributing to the prosperity of the people, and the promotion of their commerce and manufactures.

Mr. Scoles, Hon. Sec., mentioned, as a scale to the size of the Hotel buildings referred to, that the river front of Somerset House was 530 feet long, and the total height of the houses in Carlton Gardens, including the basements in St. James's Park, was 90 feet.

Mr. G. R. Burnell, C. E., stated that, in his opinion, nothing had yet been erected to equal, in magnitude and completeness, some of the great hotels of the United States; in which the arrangements for carrying up goods, washing, and cooking, were carried out by the aid of steam, in a very successful manner. The great length of the galleries in the French Hotel was an objection which would perhaps be felt more by English than by French visitors; and the same remark would apply to the appropriation of the ground floor and mezzanine to shops, obliging visitors to ascend a greater number of stairs. Very good rooms were shewn upon the plans at a height of 80 feet from the ground, requiring 160 steps to arrive at them. The laws which regulated building in France rendered it necessary that the cornice should not be more than 66 feet from the pavement;—above that height it was allowed to build in the roof, but the roof itself must be bounded within a portion of a circle of a certain radius. This law was enacted in the time of Louis XIV, and the Mansard Roof was invented for the purpose of evading its provisions. These roofs did not add to the grandeur of the buildings, but on the contrary, they had a clumsy and heavy effect, especially when seen continuously in the long streets of the Continent; and the rooms in them were necessarily uncomfortable. In the new works referred to, the architects appeared to have departed from a very good arrangement which prevailed in the time of Louis Philippe,—that of cutting off the corners of each block of buildings;—a plan which was only partially adopted in the new works under consideration. It was a very grave question in his mind, how all these expensive improvements were to be paid for.

Mr. Donaldson observed that the works were not sufficiently advanced to admit of any opinion being expressed as to the internal or domestic arrangements of the Hotel; but it should be remembered that the domestic habits of the French rendered these arrangements a more simple matter than in England. The long galleries might easily be divided by partitions. The height of the cornice was in accordance with that of the adjoining buildings previously existing; and although the latter might have been limited by the law, yet that law allowed ample latitude; indeed very few houses in London were 66 ft. in height to the cornice. The rooms in the roof were not objected to in France, and of course the charge for occupation was regulated with reference to their height from the ground. He thought the plan of cutting off the angles of the blocks was desirable only at the corners of narrow streets; as in the case of wide streets, it rendered the crossings more dangerous to pedestrians. With regard to the pecuniary question, that might be safely left to the Emperor, who knew the value and the

want of money as well as any man, and had shewn that he also knew how to use it wisely. The municipality of Paris, too, had acted most judiciously in promoting these improvements,—which must tend to make a trip to Paris so irresistible, that all the world must visit it,—and could not fail to add to the commerce and prosperity of the city. A large sum had been expended from the proceeds of the octroi in these improvements, and the result, he felt assured, would fully justify the expenditure.

Mr. H. H. Burnell, Associate, remarked, that many large houses in and near London, originally occupied by the nobility and gentry, were now let as offices; and that, if this appropriation of them should increase, it would be much better at once to adopt the French system of living in separate floors, and to build accordingly.

Mr. Ashton, Fellow, confessed that he was not much struck with any great advance which had been made by the French over the English in the new works in question, so far as Mr. Donaldson had explained and illustrated them. He concurred with Mr. Burnell in thinking the effect of the French roofs, surmounting stone walls with a heavy black mass, was very little short of ugly. The limit of 66 feet for the height of the cornice from the ground was very objectionable, and might prevent any grand architectural effect. He had himself lately built houses in Victoria Street which were 80 feet in height from the pavement to the top of the cornice. The height indeed, was a question of ground-rent; it being necessary to build such houses as would pay the expense of making new streets, and substituting large thoroughfares for narrow and crowded streets; and this argument applied as forcibly to Paris as to London.

Mr. H. H. Burnell said, that he had not observed any buildings in Paris whose arrangements were on so great a scale as those in Victoria Street. There might be some with larger rooms, but generally the French houses were smaller. The new buildings in Victoria Street were the largest ever erected for lodgings, and were exceedingly spacious and convenient.

Mr. C. H. Smith, Visitor, suggested that there did not appear to be any party-walls, or other arrangements, to prevent the extension of fire throughout the large Hotel.

Mr. Scoles observed, that both the walls and floors might be considered fire-proof, and that party-walls were consequently rendered less essential for safety.

Mr. G. R. Burnell remarked, that, generally speaking, the front walls of the Parisian houses were of dressed ashlar, and the back walls of quartering filled in with moellon.

Mr. Donaldson stated, that no wood was employed in the walls of the buildings he had described.

Mr. H. H. Burnell said, that the high roofs in question had, at all events, the advantage of being set back, so as to allow of the admission of air and light into the street.

Mr. Harding, Visitor, inquired how the different floors of these large buildings were supplied with water.

Mr. G. R. Burnell stated, that there was no water supply to any house in Paris above the first floor; that for the upper floors was afforded by the water carriers.

The Chairman, Mr. Penrose, V.P. proposed the thanks of the Institute to Mr. Donaldson for his interesting remarks, as well as to M. Hittorff, and the other architects associated with him, for their valuable donation of the contract drawings of the buildings in question.

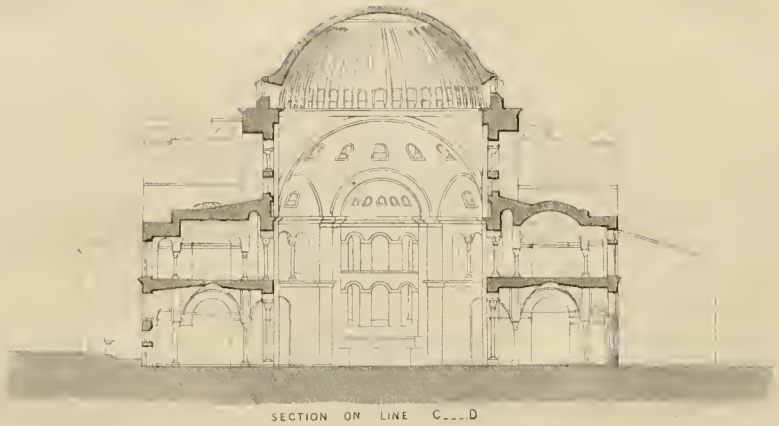
The vote having been carried, the meeting adjourned.

At the subsequent Ordinary General Meeting, February 5th, 1855,

The Chairman, Mr. T. H. Wyatt, V. P., said, before passing to the regular business of the

evening, he wished to refer to the subject of the previous meeting. In addition to the immense construction in the Rue de Rivoli described by Mr. Donaldson, our energetic neighbours and allies were building three other very large Hotels—one in the Boulevard des Capucines, on the site of the "Hôtel D'Osmond;" another, "L'Hôtel du Palais de l'Industrie," in the Champs Elysées, to contain 422 private rooms; and a third, "L'Hôtel de L'Exposition," belonging to "La Societé des Cafés, Hôtels et Restaurants de Paris."

Reference had been made to the insufficiecny of the Water supply of Paris. In the newspapers of the following day he had seen an extract from the "Journal des Débats" giving an account of a grand "projet" which was under the consideration of the Municipal Commission of Paris. It consisted in substituting for the waters of the Seine Spring Water, brought in large quantities by a gigantic Aqueduct from the Valleys of the *Marne*, between Chalons and Epernay. It was calculated to give a supply of 1,000 quarts a second, or 21,600,000 gallons per day of twenty-four hours, delivered in Paris at a height of about 250 feet. This would ensure a most abundant supply to four-fifths of Paris—the remaining portion would be provided by means of Steam Engines pumping from the present sources, viz., the Seine, the Canal de l'Ourcq, the Aqueduct of Arcueil, the Well at Grenelle, and the Waters of Belleville and the Pré St. Gervais. He believed this was very like the scheme of Napoleon I, which, he had always understood, was abandoned on account of the bad quality of the water; but it was stated that a Mons. Legrand had discovered a stream called "*la Somme Soude*," the water of which was very fresh, of extraordinary purity, and extremely agreeable to drink. He believed it was not so much a question of insufficiency of water as of the inconvenience of not having it supplied to the houses by gravitation or by artificial means, as in London. Political reasons had, no doubt, hitherto operated in this matter as in others of a sanitary nature. The "Porteurs d'Eau" of Paris were too numerous and formidable a body to be thrown out of employment. It was, however, a fine subject for the energy and powers of the present Emperor, whose comprehensive mind, he had little doubt, would find a solution of this as of many other social questions.



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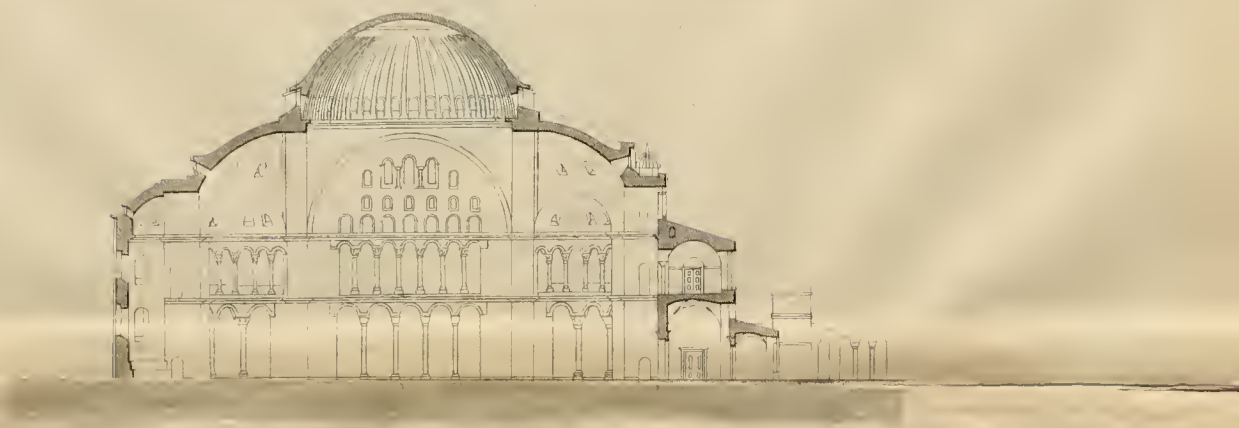

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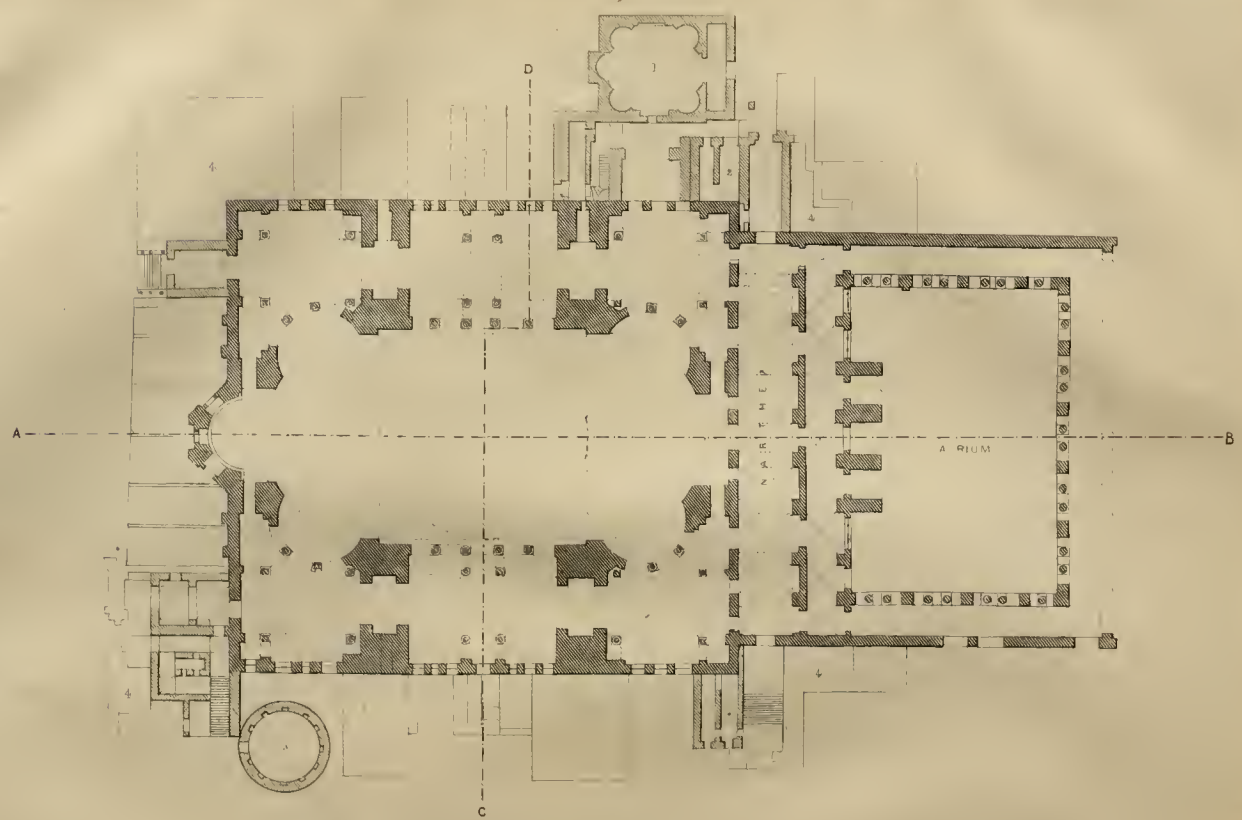

GROUND PLAN OF STA SOPHIA CONSTANTINOPLE

Scale of 0 10 20 30 40 50 60 70 80 90 100 200 300 Feet

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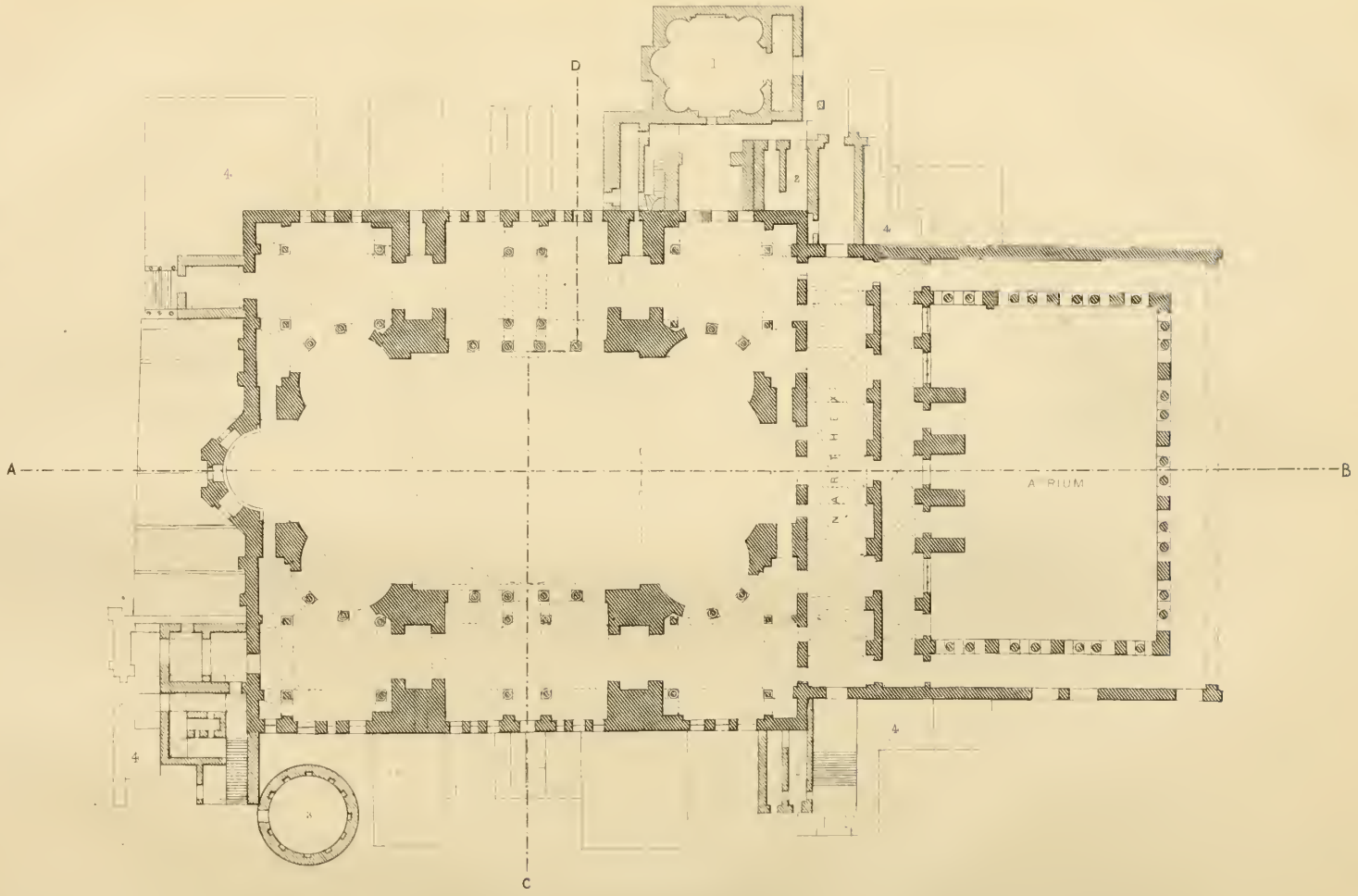

GROUND PLAN OF STA SOPHIA CONSTANTINOPLE

reduced from Salzenberg's Work.

Scale of 0 10 20 30 40 50 60 70 80 90 100 150 200 300 Feet

to face Page

SOME NOTICE OF AN ILLUSTRATED WORK BY W. SALZENBERG, ENTITLED EARLY CHRISTIAN MONUMENTS OF CONSTANTINOPLE, FROM THE FIFTH TO THE TWELFTH CENTURY.

By Charles C. Nelson, Hon. Sec.

Read at the Ordinary General Meeting of the Royal Institute of British Architects, February 5, 1855.

Much attention has been given, says Salzenberg, during the last fifty years in England, France and Germany to investigating and delineating the remains of Christian art subsequent to the Tenth century—but not previous to that date. The present day has, however, recognized the importance of the earlier style, the Byzantine, in introducing a new era and freeing the Architecture of that time from the restraints imposed by a mere imitation of the antique.

The earliest remains of Christian buildings in Constantinople, if any of them exist, date from the first half of the Fourth century, when according to Du Cange not less than four hundred and thirty religious edifices, churches, chapels and monasteries were raised in the city and its suburbs under the auspices of Constantine; but the difficulty of access to the Mosques into which the Christian churches had been converted presented insurmountable obstacles to any satisfactory investigation—especially of Sta. Sophia—till the repairs in the years 1847-1848 afforded a favourable opportunity, and the King of Prussia despatched Salzenberg to the spot. Aided by Fossati the Architect employed, he was enabled to prosecute his researches, and take full and accurate measurement of that building and its details, as well as to collect other materials for the work before us, which forms a valuable supplement to the collection of views published by Fossati from drawings made on the same occasion.*

The text affords much information on the subject of Byzantine architecture and its development in connection with antique types of Art, and the arrangements peculiar to the Christian form of worship. It also contains a full explanation of the plates, in which the Turkish additions to the ancient buildings have been omitted, or indicated only by faint lines, and the original forms have been restored, as far as possible, in conformity with the existing remains.

The largest portion of the work is devoted to Sta. Sophia, but the following buildings are also illustrated and described. The Churches are arranged in chronological order—Agios Johannes, built A.D. 463, is the only example of the Roman Basilican type remaining in the East; it has two tiers of columns on each side of the nave, a vaulted apse, and a wooden roof; the columns are of the Roman Composite order. Agios Sergios, one of the first built by Justinian in the beginning of the Sixth century, is an example of the transitional style. (Agia Sophia built 532-538, which has a cupola, and is vaulted throughout, shows the perfect development of the Byzantine style, and will be described hereafter). Agia Irene, apparently of the Eighth century, follows the type of Agia Sophia, and has a cupola. Agia Theotokos, of the end of the Ninth century, has a cupola. Agios Pantokrator, built in the first half of the Twelfth century, has a cupola and a double narthex or vestibule. The Hall on the Hebdomon, near the quarter of the city called Blachernæ (commonly designated the Palace of Constantine), is built of stone and brick, and dates apparently from the Ninth century. The cistern of Philoxenos or the Bin-bir-direk (the thousand and one columns) has columns with capitals of the cubic form, which is generally supposed to have been invented in Western Europe at a later period of the middle ages. One of the Suterasi, or water-pillars, is apparently of Byzantine and not, as such erections usually are, of Turkish origin.

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* Aya Sofia, as lately restored by order of H. M. The Sultan Abdul-Medjid. Folio. London, 1852.

Some examples of more ancient capitals of columns are given to show the influence that such remains in Greece and Asia Minor had on early Christian art in Constantinople; and drawings of three churches are introduced from Texier's work on Asia Minor to prove that after the Sixth century Sta. Sophia was generally adopted as a model in other parts of the Byzantine empire.

Though the buildings of Diocletian and Maxentius exhibit much skill in the construction of large vaultings, they show the extent to which art had declined at Rome and in the provinces. The hasty and probably slight construction, the numerous earthquakes and human violence, have prevented any of those subsequently erected by Constantine in his new capital from enduring as examples to the present time. But the remains of Justinian's buildings bear evidences of the influence of late Roman art during the first period of the Byzantine school. In them the Roman Corinthian and Composite orders are imitated, though with many deviations. The leafage is treated in an Hellenic rather than in a Roman manner—the tradition of older works previously introduced from Greece and Asia Minor. This peculiar acanthus-like treatment of the leaf ornament continues in works of the Byzantine school to the latest period, and something very similar may be observed in mediæval buildings of the West of Europe. Though the columns present an imitation of the Attic base, deep and heavy members are introduced at either end of the shaft in place of the classic apophyge. Alterations in the proportions of the entablature and its divisions, the omission of the corona in the cornice, the overcharging the entablature with egg and bead enrichment and flutings—arches springing at once from columns, or the architrave curved to form an archivolt to the arches between them—these and many other licenses to be seen in the buildings of the late Roman school may be observed in those of the early Byzantine.

The first church dedicated to Sta. Sophia by Constantine or his son Constantius, (326-360), which appears to have been a Basilica after the Roman type, with a wooden roof, was destroyed by fire during a revolt A.D. 532. Justinian entrusted the erection of the new edifice to Anthemius of Tralles. It was commenced within forty days after the fire, and having been completed in less than six years was dedicated on the 26th December, 537. Security from fire was a condition strictly enjoined on the Architect, which the vaulted construction has fully ensured to the present day, notwithstanding the numerous conflagrations that have occurred in the city.

Several remarkable deviations from the arrangement of plan observed in the earlier churches result from the particular kind of vaulted covering adopted, which consists of a cupola vault, supported over a quadrangular space by four equal semicircular arches or barrel vaults, corresponding with the sides of the square. The transition from the square to the circular form at the foot of the cupola is effected by means of gussets or pendentives, filling up the angles between the semicircular arches. The interior thus derives an imposing effect from the boldness of the vaulting, though the show of colour and of precious materials has been preferred by the Oriental Christians to correctness of form and execution in the sculptured enrichment. Columns of rare marble taken from ancient buildings, walls lined with many coloured marbles, and vaults covered with golden Mosaic—produce an interior to rival the painted walls and gilded ceilings of later basilicas. The walls and vaults are of brick; the external elevations are plain and exhibit the naked constructive forms, which divide the larger masses into portions, again subdivided and terminated by simple horizontal members. The external covering of the roof rests immediately on the vaulting. The Cupola, terminating in a contrasted curve at the base, gives the principal external character to the building. Piers, with arched window openings between them, form an external tambour for the cupola. All the windows have semicircular arched heads. Barrel and cupola vaultings prevail throughout, and the groined vaults terminate in small cupolas or domelets; later buildings, however, have ordinary groined vaults. The exterior

walls of the apso in all the examples at Constantinople present three or more faces, and never a simple circular outline.

Twenty-two years after the dedication, a violent earthquake having destroyed the eastern part of the cupola, Justinian caused it to be raised twenty-five feet; the counterforts were strengthened and the interior was renovated. Since that time, notwithstanding the numerous earthquakes* which have taken place at Constantinople in the course of thirteen centuries, the bold system of construction employed at Sta. Sophia has lasted well, and but few extensive repairs are on record. The first took place in the second part of the Ninth century, when the western arch under the cupola was restored and decorated with the figures of the Virgin, St. Peter and St. Paul in mosaic work. Another large arch was repaired probably in the first half of the Tenth century. Somewhat later, part of the cupola, injured by an earthquake, was repaired from a suspended scaffold. During the usurpation of the Latins in the Thirteenth century it is probable that little was done to preserve the building. On the return of the Greek emperors in the Fourteenth century, the eastern angles were strengthened by works called by one author Pyramids; the repairs to the bema and the great portico injured by an earthquake were commenced towards the middle of the same century, and on their completion the restoration of the mosaic work was carried out.

After the fall of Constantinople, A. D. 1453, Mahomed II. destroyed the arrangements adapted to Christian worship, and dedicated Sta. Sophia to the service of Islamism. The effects of this change are however less visible in the interior than on the exterior of the building; the form of Mahomedan worship being simple, and consisting chiefly in the repetition of daily prayer. The mihrab, a niche indicating the direction of Mecca and containing the Koran; the minber, a raised stand from which the prayer for the Sultan is repeated on Fridays; the mahfil, a platform of moderate height from which the Koran is read; lamps for illumination during the fête of the Beiram, and a carpet spread over the pavement, constitute the requirements of a Dschami, or place of meeting of the faithful, to which at Sta. Sophia the Makssure, an enclosed elevated seat for the Sultan, has been added on the north of the space formerly appropriated to the clergy. The parts appropriated to the Christian laity, the narthex, the nave, and side halls, with the womens' galleries over them, remain nearly unchanged; it is in the destruction of the gorgeous fittings of the bema, of the solea, the ambo, and other parts specially reserved for the clergy, in covering the golden mosaic vaultings with whitewash, and introducing in places huge inscriptions from the Koran, that the principal alterations have been made in the interior. Externally the addition of minarets at the angles, alterations in the adjoining spaces, and particularly the buttresses raised by the over care and want of skill of Turkish architects, have so changed the appearance of the building, that its original form can scarcely be ascertained amidst the mass of confusion.

Mahomed the Second built the first minaret at the south east angle, after he had carried up heavy buttresses in the same place. Selim the Second added the second minaret at the north east angle, 1566—1574, and restored the eastern half cupola which had been injured by an earthquake.

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* Byzantine Authors mention twenty-three violent earthquakes from the beginning of the Sixth to the middle of the Fourteenth century, seven of which occurred during the reign of Justinian, and that of the year 1033 is said to have lasted one hundred and forty days. In the Turkish Imperial History from 1511 to 1765 ten are recorded.

Numerous authors, ancient and modern, have occupied themselves with the history and description of Sta. Sophia. Among the early Byzantine writers, Procopius, Paulus Silentiarius, and Agathias, cotemporaries of Justinian, are alone deserving of confidence—the late Greek Authors abound in fabulous narratives.

Gyllius and Grelot visited the church in the 17th century—and Du Cange affords much valuable information in the Third Book of his Description of Constantinople.

His successor Amurath the Third built the two minarets at the western angles. The building had been much neglected of late years, till the present Sultan entrusted the work of restoration to Fossati, who not only carried out substantial repairs and removed many of the useless buttresses, but also effected a partial restoration of the ancient splendour of the interior; the marble work was cleaned and repolished, the golden mosaic vaulting freed from coats of white-wash, deficiencies supplied with gold leaf and ornament in oil colour, and only the personal representations on them forbidden by the Koran were again concealed to preserve them for future generations. The external face of the walls after the repair was stuccoed and painted with alternate bright yellow and reddish bands, to represent layers of stone in the style of late Byzantine and Arabian architecture.

Sta. Sophia is situated near the Palace of the Seraglio, at the eastern extremity of the present town, where the original Byzantium stood. The Apse of the Church does not exactly face the east, but, as in most churches in Constantinople, it is turned somewhat towards the south-east, the direction of Jerusalem. Of the Atrium, or fore-court on the west, only the open space remains unaltered. It was enclosed externally by walls, and surrounded on three sides by open porticos with marble columns and brick piers alternately, which supported a vaulted roof. Low buildings, the residences of the Imaums, have been built between the remaining portions of these porticos. A marble basin, of Turkish origin, occupies the site of the purifying spring in the centre. Two doors from the open space and one from each colonnade lead into the outer vestibule, which appears nearly in its original state. It has windows in the outer wall, and is covered with groined vaulting. The walls and vaulting are destitute of ornament. The four high projecting piers of squared stone next the court are supposed to have supported equestrian statues. Five doors lead from the outer into the inner vestibule, the narthex, which extends the whole breadth of the church, and is lighted by windows over the roof of the outer vestibule. The walls are lined with panelling of coloured marbles, and the vaulting is enriched with mosaic work. There is an external door at each end, and nine doors on the east side open into the church; the central one, which is the largest, was designated the Royal door. The external main walls of the church enclose a space which is nearly square—the length inside, exclusive of the eastern apse, being 241 and the breadth 224 feet.* In the middle, four strong semi-circular arches, supported on piers at the angles of a square space, carry the cupola. To the eastern and western of these arches large semicircular niches are attached, each of which is connected with three other niches of smaller dimensions. The two large niches are covered with half cupolas, which abut against the main arches already described. Four of the smaller niches are semicircular in plan, and covered with half cupolas which intersect the large half cupolas, but the central niches or recesses are covered with barrel vaulting—and to the eastern one is attached another simicircular recess covered with a half copula, which projects from the general mass externally and forms the usual eastern apse. Between the four main arches in the centre pendentive vaults are introduced, which meet in a circle 100 ft. in diameter. This circle forms a gallery at the springing of the great cupola, which there measures 104 ft. across between the ribs, and rises at the crown to the height internally of 179 ft. from the pavement. On the north and south of the central nave and separated from it by columns supporting arches, are side halls, each in three compartments. They are repeated on an upper floor to form the gynæceum or womens' choir (accessible by stairs at each end), which is continued as a gallery over the narthex or inner vestibule. The covering of all these spaces is vaulted

* All the dimensions are given in Prussian feet, one hundred of which are equal to 103 English, or one foot is equal to 1.03 English.

throughout on both floors, the vaulting being carried by wall piers and the main walls, and by forty columns and eight detached pilasters in the lower, and by sixty columns in the upper story. Numerous windows in the outer walls; forty at the base of the central cupola and others in the semicupolas admit a flood of light to illuminate the marble linings of the walls, and the mosaic work of the vaultings.

The materials used in the construction of the building are brick and a kind of peperino free-stone, the latter where great pressure occurs, as in the four main piers of the cupola and the adjoining piers, and in those carrying the arched ribs in the side halls. A course of stone two feet high is laid about four feet above the pavement all round the building. The original external walls and vaultings are of brick; the later additions show alternate layers of brick and quarry stone. The Turkish counterforts are of wrought stone. The bricks measure generally 14 in. by 2 in. Some in the vaultings are 14 in. square, by 2 in. thick. In the lower part of the great cupola some are 27 in. long, 9 in. wide, and 2 in. thick, and others are 27 in. square on the side. The light bricks from Rhodes mentioned by early authors are not to be found, those used are made of ordinary earth, well burnt; but to fill in the pendentives under the cupola, a whitish stalactical material, shewing the impression of plants, was used in its rough state. The mortar is of a reddish colour, apparently from the addition of pounded tile, and is laid in thicknesses of one to two inches. The ornamental cornices, entablatures, capitals, and bases (all of Byzantine style), some of the shafts, the parapets to the galleries, with the window frames and bars are made of marble from the island of Proconnesus (now Marmora); which is of a whitish colour shaded with light greyish blue, similar to the so called architectural marble of Carrara. Many of the shafts as well as the slabs lining the walls are of various rare marbles and porphyries. The monolithic shafts were taken from ancient buildings; on the ground floor they are of verd antique (25½ ft. high, 3 ft. 7 in. diameter), except the eight in the side niches, which belonged to Aurelian's temple to the Sun, and are of deep red Thebaic porphyry. Many discrepancies in height and size are observable. Molded bands of bronze 9 in. to 11 in. high, are fixed at each end of the shafts, either for security or to conceal injuries. These bands were gilt as well as the leafage of the capitals. The pavement is now of whitish marble striped with dark grey; remains of the original marble mosaic pavement are visible only in two places, viz.:—in the south eastern angle of the quadrangular space under the cupola, and in the western gynæceum. The larger slabs of the marble linings are from one to two inches thick, and are secured to the walls with iron cramps and lime mortar. The marble mosaics in the friezes and tablets are formed of pieces $\frac{1}{4}$ to $\frac{3}{16}$ in. thick, joined together on a layer of liquid dark brown resin mixed with fragments of marble and tile. The slabs so formed are about one inch thick, and when hardened were attached to the walls with the same liquified resin.

The main enclosing walls are about 70 ft. high, and are 3 ft. 6 in. thick on the north and south, 4 ft. 6 in. on the east, and 5 ft. on the west, between the nave and the narthex. Piers projecting two feet are introduced internally where the arch ribs rest against the walls. The barrel vaulting of the interior passes through the walls and appears as an arch on the outer surface. All the door and window openings are covered with semicircular arches, and the marble dressings and perforated fillings in were inserted after the completion of the work.

The principal cupola appears at first sight to rest upon four arches, each 100 ft. wide, but in fact only those on the east and west have that span, and on the north and south the real supporting arches are diminished in width to 72 ft. and only $\frac{3}{4}$ of the circumference of these last arches has radiating joints, the parts next the springing being laid horizontally. The buttresses attached to the main piers on the north and south were at first only carried up to the spring of the great arches, and

were concealed beneath the roofs over the side galleries, but after the fall of the dome they were raised by command of Justinian, so that they now are within 18 ft. of the basis of the cupola, and form vast projecting masses, necessary perhaps for the stability, but certainly injurious to the external appearance of the building.

The basis of the cupola consists of forty piers resting on the internal circular cornice; they are 3 ft. 5 wide inside, 8½ ft. long in the direction of the radius, and tapering on the outer face have a medium height of 15 ft.; they are connected together by arches, which form windows 4 ft. 9 wide. They project externally and now support metal plates, curved to correspond with the window heads, but they probably once carried brick arches and served as an effective tambour to the cupola; above them still remain indications of further enrichment. The piers are continued as ribs on the inside of the vault (which begins with a thickness of 29 in. over the windows); they project at first 6 in., gradually decrease, and die away into the great central disk of the cupola, which is 37½ in. diameter. At the crown the cupola is only 24 in. thick measured through the holes left for suspending lamps.* The lowest inner faces of the piers are 104 ft. apart, measured diametrically across. The highest point of the cupola rises 46¾ ft. above the gallery at the base; the vaulting of the cupola is therefore less than a semicircle in section. The first cupola must have been much flatter, as according to Agathias the second was made narrower and higher; Theophanes states the increase in height to be 20 ft., Zonaras 25 ft. The cupola was surmounted by a cross. It is evident on close inspection that many hard blows have fallen on it in the lapse of thirteen centuries, its regular shape being destroyed by many swellings and depressions, which, however, are not seen from the ground, while they prove the durability of a cupola vault so long as its supports remain firm. The side halls are vaulted on the same system as the large cupola; four barrel arches enclosing a rectangular space carry a flat cupola. The lower side halls exhibit a mixture of cross and domical vaulting, the groins terminating in very flat cupolas. In the upper galleries or women's choir the cupolas are higher, and they answer in section to a sphere whose diameter equals the diagonal of the rectangular space over which it is placed. The vaulting of the narthex resembles that of the side halls, the outer narthex has ordinary cross vaulting.

All the arches on columns round the nave, both below and in the women's choir, have iron tyes; in the three greater arches belonging to the gallery at the west end of the nave there are wooden straining beams under these iron tyes. In the lower row of windows of the north and south walls of the central nave an iron tye was also visible, which appeared to extend through the whole span of the main arch. All the vaults which serve as roofs are covered with sheets of lead ¼ in. thick, fastened to wood laths resting directly on the vaults without any wooden roofing. As they must consequently be repaired from the outside, several stairs and gangways giving access to all parts are provided; and only the main cupola requires ladders to be raised from its base for that purpose.

The cupola of St. Peter's at Rome is not seen with effect till the spectator is beneath it, and its supports equal half the space left free; from the central entrance door of Sta. Sophia, the eye embraces at a glance the greater part of the interior with the aerial cupola, the supports of which amount to barely one-tenth of the unencumbered space.

Of the three kinds of interior decoration employed, sculpture, marble linings, and glass mosaic painting, (oil painting was not used, unless gilding the ornaments in relief be considered such) the first holds only a subordinate place, and is obviously not a main element of Byzantine art; but the marble decoration is in unison with the Oriental taste for show and glittering colours,

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* The western barrel vault of the nave is 4 feet, and the eastern half cupola 3 feet in thickness.

which was gratified by the display of rare and precious materials, taken from ancient temples throughout the empire. All the walls of the interior of the church and narthex are lined, from the pavement to the vaulting, with slabs and bands of variously coloured marbles. In the church the mass is divided horizontally by two cornices of white marble, simple in profile and enriched with leaf ornaments, and a cornice is carried round the foot of the cupola. All the bands, as well as the panels, are surrounded by narrow borders of white marble, charged with fret work. The larger panels have wider borders of the same material, carved with ribbons and rosettes between frets and beads; by this means a marked division of the various marbles is obtained. Single friezes and panels are further ornamented by mosaic work, like the Florentine, representing leafage and tendrils, flowers, fruits and animals. The arches and spandrils over the columns between the great piers in the nave are covered with relief ornament in white marble; on the upper floor these parts contain mosaic work of coloured marble. The ornament, which has a peculiar stencilled character, was once gilt, and the remains of deep red colour are seen in the sinkings. The walls of the bema are of the richest description, being almost entirely covered with slabs of marble mosaic; they formed with the barrel vault over them the arcus triumphalis, under which stood the gorgeous ciborium and the holy table. The walls of the adjoining apse, which contained the patriarchal chair and the seats of the priests, are less ornamented.

In obedience to the command that combustible materials should be avoided, the window openings are filled with bars of marble or stone, and the leaves of the doors were of bronze or of wood covered with it. The larger window openings are subdivided by piers or columns, with narrow architraves or transoms fixed midway in the height. Perforated slabs, 4 in. thick, form the window bars, which are about $3\frac{1}{2}$ in. wide, and are splayed inwardly. The panes of glass* (originally cast singly) vary in height from 9 to 10 in. by 7 to 8 in. in width. The door dressings are of marble, with the exception of those belonging to the royal door which are of bronze. Of the bronze door leaves, those at the south end of the narthex are alone deserving of special notice. They are apparently formed of Hellenic work of the best kind taken from some ancient temple, with Byzantine additions to adapt them to the opening. The plates of bronze, $\frac{1}{8}$ to $\frac{1}{4}$ in. thick in the old part, $\frac{3}{8}$ to $\frac{1}{2}$ in. in the later, are fixed on leaves of wood 4 to 5 in. in thickness.

According to Paulus Silentiarius, the ambo was placed centrally between the main eastern piers, but advanced somewhat westward, and beneath it the singers stood behind a barrier. Behind the ambo, the solea, appropriated to the inferior clergy, occupied the whole of the space under the eastern half cupola, which was separated from the rest of the nave by a low divisional wall. The smaller semicircular recesses, adjoining on the north and south, termed the prothesis and the diaconum, were used for purposes connected with Divine worship. Between the smaller eastern piers under the half cupola, a screen about 14 feet in height, ornamented with twelve columns and having three doorways, divided the solea from the bema, which occupied the whole of the central eastern recess. The altar, covered by the ciborium or baldachino, was elevated under the arcus triumphalis of the bema; and the patriarchal chair and the seats for the superior clergy were placed in the curve of the semicircular apse. The rest of the ground floor was given up to the laity. The place of the emperor was enclosed at the east end of the south side hall, that of the empress was in the middle division of the women's choir, probably on the south side, which was connected with the Palace. Fifty priests, one hundred male and forty female deacons, ninety sub-deacons, one hundred lectors, twenty-five cantors, and one hundred ostiarii, were attached to the establishment in the time of Justinian. Heraclius fixed the

* It is doubtful whether the glass panes in the windows belonged originally to the building.

number at eighty priests, one hundred and fifty male and forty female deacons, seventy sub-deacons, one hundred and sixty lectors, twenty-five cantors, and seventy-five ostiarii; but the clergy served also three other churches in the neighbourhood.

A cupola church arranged in conformity with the example of Justinian's building, which served as type till late in the middle ages, presents a square figure containing the arms of a cross covered with barrel vaults, their intersection crowned by a high cupola raised on a drum or tambour. The four spaces between the angles of the square and the cross are covered with small cupolas or domelets, and are lower than the arms of the cross. These parts together constitute the nave. The eastern arm is usually extended to form the bema for the clergy and is terminated by the principal apse. The two spaces at the eastern angles are lengthened in a corresponding manner and terminated by the side apses. At the west end the vestibule, the single or double narthex, occupies the whole width of the Church. The plan of the whole church is therefore oblong, from which three apses project at the eastern end, and in which the nave is marked as a cross. In smaller churches the extension eastwards is omitted, and the three apses are directly connected with the square of the plan, which is lengthened only towards the west by the vestibule or narthex. In large churches the women's choir or galleries occupy the north and south arms of the cross and the spaces at the angles, which are thrown together by arched openings in the walls between them. In this case there is a connecting gallery over the narthex. In small churches the galleries or women's choir are omitted, and the barrel vaultings are supported on arched ribs, springing from piers attached to the enclosing walls, and from four columns or detached piers under the cupola. This disposition, which leaves the quadrilateral space of the nave unencumbered, the cupola as well as the barrel vaults at the intersection of the cross resting only on the four supports, belongs to the later time of the Byzantine school. To the above arrangements were attached at the western end the atrium or fore court with its porticos and entrance.

Mr. Nelson, after alluding to the discrepancies existing in different accounts as to the dimensions and other particulars of the dome or cupola of Sta. Sophia, expressed a hope that another evening might be devoted to domes, as much more might be said upon the subject generally; and he hoped, in reference to Sta. Sophia, they might have the benefit of Mr. Petit's researches on the question of Byzantine architecture, and its applicability in the present time. Mr. Garbett's work might also be consulted on the subject, as the author traced the change from the Roman style of cross-vaulting to that used at Sta. Sophia, and compared the cross or groined with the domical, and pointed out the merits and defects of each in a very clear manner. It would be interesting to consider the different modes of lighting domes; the ancient western example, the Pantheon, was lighted from the centre; the eastern ones from the sides; and the modern domes of Europe from the centre. He then referred to a diagram shewing how domes had been progressively heightened, from the proportions found in the Pantheon to those of the most recent building.

Mr. Donaldson, Hon. Sec. For. Cor. having made some remarks as to the women's galleries,

Mr. Papworth, Fellow, went into the question at some length, referring to the plan of Sta. Sophia in explanation. He then enquired whether the bema was occupied by the bishop, or the presiding presbyter and his assistants, when there was a screen shutting out the view of the sanctum from the body of the church.

Mr. Heneker, Associate, referred to the church of S. Ambrogio at Milan, and the cathedral at Torcello, where the apse still showed precisely the same arrangement as in the most ancient times.

Mr. Donaldson observed that there was a distinction between the Greek and the Roman Catholic forms.

Mr. Heneker replied, that the Greek forms were introduced into the earliest Italian churches, and, at the time of the erection of the two edifices referred to by him, the Roman had indeed scarcely separated from the Greek church. Almost all the types of the Greek church, and the forms of Greek monuments, might have been carried to Torcello, and indeed the same forms were generally introduced in the most ancient churches of Northern Italy as in Constantinople.

After some further remarks by Mr. Donaldson respecting the internal arrangements of the Greek and Latin churches,

Mr. Nelson suggested that if that question were to be discussed, it would be very desirable that the Institute should, at the next meeting, have the benefit of the attendance of the Rev. Mr. Burgess, whose knowledge of the subject was shown in a paper on the Ancient Basilica, read at the Institute a year or two ago. It appeared, however, to him, that the main question for consideration was the construction and decoration of the church of S. Sophia, and other analogous edifices.

The Chairman, Mr. T. H. Wyatt, V.P. proposed the thanks of the meeting to Mr. Nelson for the great pains he had taken in making known to the members the contents of Salzenberg's valuable work, which would otherwise have been to himself, and probably to many others, a sealed book. He then stated, that in compliance with the general wish the subject would be resumed at the next meeting, when Mr. Digby Wyatt would offer some observations on the mosaic and other decorations of the Church of Sta. Sophia.

REMARKS ON THE MOSAICS AND OTHER DECORATIONS OF THE CHURCH OF STA. SOPHIA, CONSTANTINOPLE.

By M. Digby Wyatt, Fellow.

Addressed to the Ordinary General Meeting of the Royal Institute of British Architects, Feb. 19, 1855.

Mr. Wyatt spoke as follows:—Gentlemen, the subject for consideration this evening is based upon the ground which was opened by Mr. Nelson at your last meeting. On that occasion he not only trenched the ground, but he reared the foundations and re-built the edifice of Sta. Sophia, giving you a good idea of the distribution and the main structural features of the building. Mr. Nelson was pleased to leave to me the task of conveying to your minds some idea of the magnificent clothing and completion of the carcase; and that forms the subject upon which I propose to address you this evening.

The decoration of Sta. Sophia is of two principal kinds; one consists of a certain number of points, more or less structural, to which I shall first call your attention; and the other of a system of mosaic ornamentation of the highest importance in relation to the history of that art—so important, indeed, that I propose to bring under your notice first, the mosaics of Sta. Sophia as they exist; secondly, their historical position as compared with other mosaics; and thirdly, their peculiar technicalities of production; so that our review may embrace, not only the artistical nature of these magnificent monuments of early Christian art, but their historical position, and the actual mechanical operations by which they were executed.

The principal technical point in relation to the general working of the sculptured ornament of Sta. Sophia to which I would call your attention is displayed, almost universally, in the capitals and other carved features which stamp Byzantine architecture with its leading peculiarities of style. In classical architecture, the principle of superadding foliage to construction was generally followed, and in obedience to this law both ancient Greeks and Romans usually adopted a bell or a moulding line as a basis, and then planted on such a fundamental form whatever decoration of leafage they desired to use. The Byzantine architects departed from that system by first cutting their stone-work into the general shape required, and then sinking or draughting into it all their different enrichments; and from this it follows as a corollary, that Classic ornament was completed before the erection of the block of stone or marble decorated, and that Byzantine was executed subsequently to the fitting in place of the main structural forms. This is the general principle which distinguishes Byzantine from Latin work; and wherever we recognise its adoption in the architecture of India, Russia, Lombardy, or the North, we may be sure that the influence of the Byzantine school was paramount; as was especially the case at Pisa and in Sicily. As Byzantine architecture reached its earliest, as well as its highest, development in Sta. Sophia, it becomes exceedingly interesting to recognise the unquestionable assertion of this principle by its architects and artificers.

The second point with regard to ornamental decoration to which I shall allude is very important, since it materially affects the history of both plain and coloured glass. The windows of Sta. Sophia are formed of a series of slabs of marble, pierced in apertures of about 8 inches by 10. In these sash-bars, as I may call them, there is a rebate left on the outside in all cases, and it appears to me most probable that these apertures were filled in with coloured glass. The reason I have for thinking so is, that we know that the Byzantines were perfectly well acquainted with all the processes of glass-making. Their enamels were proverbially beautiful, and Buonarotti has given us

many interesting details concerning their glass vessels, which they painted with fluxes, and decorated by other processes at a very early period. Of many varieties of such vessels there are specimens existing in the Museum Christianum of the Vatican at Rome. These actual remains prove to us that they were masters of the technicalities of glass-work. Paulus Silentiarius alludes to the beautiful effect of light and colour in this building of Sta. Sophia, when seen in the early morning; and Paul the Hermit, and Fortunatus of Poictiers, in his "Carmina," also describe this effect. Theophilus, who was a writer on the technical arts a little before our Conquest, has a whole treatise upon the subject of stained glass, which he prefaces by stating that he had taken the pains to go to Sta. Sophia to examine the effect of the light, coloured by transmission, in order to qualify himself for writing this section of his book. When it is remembered that Sta. Sophia was commenced in the year 532, and completed about 540, it is interesting to have grounds for the belief that stained glass was extensively used at such an early period.

Until recently the assertion of the Benedictines, that coloured glass was not known previously to the time of Charlemagne, has been generally regarded as correct. French and English antiquaries have, however, found allusions to its existence at a much earlier period, as early indeed as the year 600, and the details now given to the world concerning Sta. Sophia afford a strong corroboration of their views.

These windows, in their general form, present a certain number of square compartments, by filling in some of which and omitting others a Greek Cross would be produced in the centre opening, and crosses, similar to those carved beneath the window, in the side openings, supposing such an ornament was wanted. Although frequently alluded to by ancient writers, few remains exist agreeing with what they called the "simplex fenestra;" but it appears that in the early days of the history of coloured glass, that was the most common form; and I have little doubt that the windows of Sta. Sophia presented the primitive type of such windows as those which Benedict and Biscop, according to Bede, introduced into this country in the seventh century.

Another circumstance which corroborates my view that there was stained glass in Sta. Sophia, is that the Eastern nations generally, whose architecture was originally based on that of Byzantium, have windows cut or pierced out of stone, and occasionally made up with plaster, on the weather side of which they fix pieces of coloured glass of singular shape and pattern. Occasionally these windows are introduced in domes, and in such cases the stone or plaster inside forms the lines of the dome, and light enters through the little pieces of stained glass which cover the apertures, which are formed into simple geometrical patterns, as they would be in this pierced part of the dome of Sta. Sophia.

Those are the most important special points to be noticed, so far as the building of Sta. Sophia itself is concerned; but since its peculiarities of style and the novelties of form introduced in its construction can be properly appreciated only by contrast with the monuments which preceded it, we shall glance for a few moments at them.

One of the plates in Salzenberg's work, to which Mr. Nelson did not particularly allude, gives illustrations, showing the extent to which the Latin or Basilican arrangement was carried in the Church of Agios Johannes, built by Leo the Great, in 463, only seventy years before Justinian commenced the building of Sta. Sophia. We find in that church a perfect basilican arrangement, exactly similar to that of Sta. Agnese at Rome, with narthex, apse, choros, second story, forming galleries for females, &c. complete. A hasty comparison of the plan of this church with that of Sta. Sophia shows how the Latin mode of arrangement differed from the Byzantine, while a close investigation of the subject generally will demonstrate that, as the styles were retained clearly and distinctly in architecture, they were no less so in portraiture and ideal painting.

Proceeding now to the mosaics of Sta. Sophia itself, I will begin by describing the visitor's impressions on entering and making the circuit of the building. He first passes through a small and rather unimportant pro-narthex, or portico, which conducts him into the long gallery, which is the real narthex. As it is in this gallery that we first meet with any indication of Byzantine individuality of faith and character, I may be allowed perhaps to dwell briefly upon qualities which lie at the very root of the outward and visible forms in which much religious fervour was for ages embodied, not only by means of mosaic, but by calligraphy, sculpture in stone, metal, and ivory, embroidery, and every process by which the voice of art has ever hitherto appealed to the heart and conscience of man. Now, the great distinction between the Byzantine and Latin modes of working out religious conceptions (that is, between the Eastern and the Western modes) is, that, in the Western or Latin mode, symbolism was universal. The art of the Catacombs was followed distinctly, though frequently remotely, developing itself in mythical and sentimental forms, and systems of parallelism between type and prototype. In the Greek Church, the exposition of faith through art took a more tangible form. Symbolism was avoided on all possible occasions; and direct representation led to a partial transfer to the representation of the adoration due to the thing represented. In the advanced periods of Greek art, this realistic tendency led to a painful view of the nature of religion, more particularly in connection with the martyrdom of saints, and the physical sufferings of our Saviour and his followers, which were represented in the most positive and often repellent forms.

I stop at this point to point out that over the entrance door is to be found the only piece of symbolism throughout the building. Over that door is a small panel cut in stone, intersecting the mouldings of the architrave and containing a representation of a sort of enclosure or "cancellum," with a seat of honour, and upon it an open book with the Holy Ghost in the figure of a dove descending upon it; being, in fact, the Spirit of Holy Wisdom (to which Justinian dedicated his Church) embodied. The inscription on the book is, "I am the door for the sheep; let him who is fitted enter, and he may walk in and out, and there shall he find pasture."

Numerous doors from the narthex lead into the main building. The whole of the sides of the walls were lined with precious marbles to a certain height, and above that commenced the mosaic work. This is, like all Byzantine glass mosaic work, on *a gold ground;* but it also has the peculiarity (unique, so far as I, or anybody I know, is aware of), that it has in its patterns, in addition to gold mosaics, *silver mosaics.*

There is a very valuable MS. known as the Lucca MS., supposed to be of the seventh or eighth century, and printed by Muratori, in his great "Annali d'Italia," in which the writer gives an account of the process of making golden and silver mosaics. Both in the "Schedula diversarum Artium," of Theophilus, and in another MS. of rather later date, about the year 1200, known as the "Mappæ clavicula," or key to drawing), published by Sir Thos. Phillips in the Archæologia, and supposed to be an English work, there is an almost identical description of the art of making mosaics, but omitting any special allusion to silver work. In writing a book on the subject some time ago I mentioned this process, though I was not then aware of the existence of any actual specimen of it; and I am therefore very glad to recognise it in Sta. Sophia, since it proves that the old writer of the Lucca MS. described things which really existed, and not myths or traditions only. You will see that the silver mosaics shown in the drawing are in the great groined vault of this gallery. It is constructionally a groin as far as the middle portion, where it becomes a flattish dome. You will see how cleverly the artist has given the idea of its being a groin to a certain extent, by following the intersecting line of the vault with his decorative lines, and then has indicated its

termination in a domical form, by the introduction of a central circular ornament. In this part some of the silver ground mosaic is introduced.

We here meet with a very interesting and entirely new element of design, which is totally different from any of the Roman ornament. A comparison of these with analogous Latin remains will show that the latter are almost entirely imitations of antique work; but *here*, coupled with these silver mosaics, we find a distinctly oriental character of decoration. It is again repeated in other mosaics—particularly in *this* form of leaf, which is quite oriental in character.

Now, it is a curious fact, that the year in which Sta. Sophia was commenced was the very year in which Justinian concluded an eternal peace with Chosroes Nushirvan King of Persia. We know that in one or two reigns antecedent to his Greek artists had been employed in Persia, and that there had been a friendly communication between the two countries. We may therefore assume, that when Justinian proposed to build this structure in so short a time, he not only enlisted the ability of those about him, but that he attracted back those erring spirits who had gone to seek their fortunes in other countries. He probably, indeed, employed not only his own subjects, but foreigners—and in that way we may believe that a considerable portion of what no one can fail to recognise as Oriental art was mixed with Byzantine.

The principal portion of the mosaic work in the narthex is over the centre door, which was known as the King's door; and there we find a very beautiful mosaic, which represents the figure of Our Saviour in the act of benediction.

There is a peculiarity about the mode of benediction which it may be interesting to point out. The Latin benediction was given with the thumb and two fingers extended, representing the Trinity. *Here*, however, the first finger is presented straight—representing the J in "Jesus"—the second is crooked, to form the Greek capital S in the same word—the third finger is crossed to it, but still bent, to make the Ch for "Christus"—and the fourth is bent to make the S the last letter, and in that ingenious way the benediction appears to have been given, as here represented.

The book held by Our Saviour in this mosaic bears the words in Greek, "Peace to you. I am the light of the world;" confirming the view that it is actually the representation of Our Saviour. In medallions, on one side is the Virgin Mary, and on the other the Archangel Michael holding the abacus, which was a symbol of chiefdom. There is another figure, prostrated in the Eastern manner introduced by Diocletian. There has been a question as to whom this figure represents. Salzenberg supposes it to be Justinian himself. Fossati says it is Constantine Pogonatus. I think the mosaic is certainly of Justinian's time, and that it is a *capo d'opera*—the best piece of all the mosaics and one upon which the artist would take most pains, and that it therefore probably represents the great Emperor himself. It appears to be in good preservation. Unfortunately Sta. Sophia has suffered very much indeed, and the highest class of representations is that which has been most injured; because, as the Mussulman could not bear the representations of the Giaour, they covered them up as far as possible, and damaged them wherever they could.

Passing through the King's door, and turning to the right or left, we enter the side halls which are groined over with flattened heads to the groins, just as in the narthex; and the mosaics are of a similar character. They exhibit the same principle of marking all the arch lines and the lines of the vaults, and indicating the round basin-shaped termination by a circular ornament in the centre.

It is remarkable that in these mosaics there is no religious symbol but the cross; a circumstance which does not occur in any building of the period in the Latin Church.

Leaving the under part of these galleries, appropriated to the men, for the upper part (or *gynæceum*) appropriated to the women, we find the richest kind of mosaics, placed there no doubt because they were conspicuous from the nave below through the openings between the pillars of the upper arcade. From the central point of view under the great cupola, these domes and groins would appear to great advantage and have a very beautiful effect. Here appear to have been a certain number of domical parts rising to a higher basin-shape than the lower vaults. The prints show the decorations of these parts. There are only two existing, and of them only some small fragments are perfect; but there is enough to make out that the central subject was Our Saviour, and round him the Twelve Apostles, with the fire descending from Heaven upon their heads; a representation of the Day of Pentecost. The figures in the pendentives are spectators looking up in wonder at the miracle.

These patterns are the triumph of the whole series of illustrations of surface decoration. They are singularly beautiful, and in them we find the taste of the master architects themselves displayed, who no doubt gave the predominant lines; and we see, as might be expected from Anthemius of Tralles and Isodorus of Miletus, a remarkable retention of Greek forms, as in *this* moulding; while in others an oriental character is introduced apparently by the workman or "pattern drawer," an occupation which has ever remained distinct in the East from that of the architect or builder.

The central nave has a great semi-conch at each end, with subsidiary conchæ opening into them. From the springing level of the greater conchæ the pendentives start, and over them rises the main dome. It appears that the decoration of both conchæ and of the great hollow of the roof, was plain gold ground mosaic. The main western and eastern arches were ornamented, but both of them were executed at a period subsequent to that of Justinian, or at any rate some accident may have happened to them, and what now appears is of a later era.

The principal mosaics of this part of the central nave are between the windows. Underneath the windows are a series of Greek saints in arched recesses, St. Gregory, St. Nicholas, St. Basil, St. Anthemius, and others. The figures are very dignified; they wear the pallia so conspicuous in the bishop's dress of the Greek church. Above them stand the twelve minor prophets, and at the ends are two larger figures on each side, representing the four greater prophets. Above are some slight remains of four figures, supposed to be the four evangelists.

In the pendentives there are enormous seraphim. *Here* is a representation of the head of one of them, and *this* drawing shows the way in which their wings are combined. These figures are of immense scale, and fitly carry up the eye to this "empyrean"—(the dome itself). The effect produced in this dome by the cross lights admitted through the coloured windows at its base, must have been that of an air of mist and rainbow-tinted vapour, so that any great picture at the summit would appear to be floating in it, especially if the glass contained a predominance of blue. The The ancient writers describe a great figure of the Almighty in this place. So that, in looking at this series of mosaics, we ascend the gradations of the saints, the prophets, and the evangelists to the abode of Deity itself;—a very beautiful conception, and very beautifully worked out.

As we enter the bema or sanctuary, we find that *here*, over the high altar, stood guardian angels. The whole arrangement of the east end is very simple; there is no dramatic story told, but the treatment is noble and impressive.

Architecturally speaking, there is great ability displayed in the introduction of lines of colour on the ribs of the great dome, to give the gold which occupies the spaces between the ribs tint and substance. The rib patterns are shewn on the drawing. The detail looks coarse, but as it was very distant from the eye, the forms and colours required to be strongly contrasted.

This is a section through the windows at the base of the dome. As the light played on their

illuminated jambs or sides, and flowed across this coloured work, the effect must have been quite exquisite.

The two main arches having to do the principal work in the support of the dome have suffered most, and have consequently needed reparation. This western one was repaired in the time of Basil the Macedonian, late in the ninth century. The other or eastern one was restored in the time of Johannes Palœologus (about the year 1345). The first of these has in the centre a representation of the Virgin Mary, with St. Peter and St. Paul on each side, and two other figures which are not very clear. On the other is a representation of a sort of throne which is very much defaced, and figures of the Virgin Mary, St. John the Baptist, and Johannes Palœologus himself, who repaired the arch. The presence of the Virgin as she is represented in the picture would at once indicate a later date than that of Justinian, even if we did not know the exact period of its execution.

I have hitherto only alluded to the gold-ground mosaics; but they are by no means the only kind of decoration, as up to the height of the springing of the main arches supporting the dome, the whole wall is covered with slabs of precious marbles, no doubt in imitation of the wall-covering that helped to make the Pantheon so celebrated a monument, and so worthy of imitation by all the eastern successors to the glories of Rome.

The mosaics of all this wall-covering are very interesting, because they consist not only of slabs of marble put together like the antique, but of marbles cut out and fitted into each other, like Florentine mosaic. In addition to this, in *pietra dura*, there is a curious mosaic made up with a resinous composition. It forms the spandrels of the arches of the *gynœceum*, and other places. Some of the lines in these ornaments are so fine that it was necessary to cut it out of very thin marble indeed, and of various thicknesses. As it was difficult in such delicate work to pierce a thick slab truly, the slabs were thinned down in parts to $\frac{1}{4}$ or $\frac{3}{8}$ of an inch; and where the line required to be very thin, the marble was sloped away at the back and cut through clean. Resin mixed with marble dust and other substances was poured over it to make what would be less than $\frac{1}{2}$ an inch thick into the thickness of about 1 inch. It was then fastened to the wall with cramps, and more hot resin was poured behind the cramps to make the whole secure. The patterns of this style of work are curious, as they have a mixture of the old Greek in them.

The drawings show the principal details of the pictorial mosaics. *Here* is one of the greater prophets, which displays a fine dignified character. *This* is the arch of Basil the Macedonian. *Here* we have the Jewish type of the Madonna, the head covered exactly in the manner delineated by Michael Angelo, who perhaps more than any other artist of the revival clung to the Byzantine type, as in the head of his Pietà, which you will remember has a youthful expression, and a head-dress exactly resembling *this*. There is very little left of this arch, but it belongs to a good period, whereas the arch of Johannes Palœologus is a specimen of an already decrepit school of art.

I may observe in reference to all the mosaics of Sta. Sophia, that their workmanship appears to be excellent, both as to the putting together, or "commettitura," on which the Italians pique themselves, and the general drawing; there is none of that bad colour, and weak repetition of line to mark the drapery, that we find in the later Byzantine works. This early and noble style asserted itself in perfection at this, the highest period of its development.

The pavement of Sta. Sophia was executed very much upon the principle of the pavement of the Pantheon at Rome. It was not so much *opus Alexandrinum*, made out of small pieces of porphyry and serpentine, as of large slabs put together, and forming the pavement known to the ancients as *opus Sectile*. In the church of Agios Johannes (built as I have mentioned, about 70 years before Sta. Sophia), the pavement is filled in with small mosaics, in the regular Latin style, similar to

that which was originally introduced at Rome by Alexander Severus. The pavement of Sta. Sophia appears to be in the style specially affected by the Greeks, since it is similar to that followed at S. Marco, which was originally executed from Byzantine models, though doubtless repaired in many parts by Latin workmen.

I trust from the description given that you may now be in a position to form a tolerable general idea of the decorative features of Sta. Sophia, and I will therefore proceed to advert to the historical position which these mosaics occupy.

As we have given (as everybody who looks at Sta. Sophia must) the highest credit to the Byzantines for architectural originality in every form,—in capitals, mouldings, &c.,—they can afford to spare a little of the reputation usually attributed to them of being the only mosaicists. Writers constantly allude to "Greek mosaic," as though there were no other kinds. It is to be remembered on the contrary, that the gold-ground mosaic was essentially an old Roman art. We know that Pliny describes distinctly the introduction by Agrippa of glass mosaic; and we know that the most ancient mosaic was known as *lithostratum*, being made of stones, and was taken from the Greek. As the exigencies demanded by improvements in the art went on, more colours were wanted than could be found in natural substances, and to supply such wants fictile materials were invented. In such glassy substances the Romans produced all the colours employed in the most celebrated antique mosaics, such as Pliny's Doves, the battle of Issus, &c. Pompeii contains numbers of specimens of gold-ground mosaic, perfectly well made, as pure in colouring, as little obscured as when they were first executed, and as excellent in every technical respect as any of the best Greek mosaics. We know that in the house of which Mr. Falkener gave such a beautiful illustration in the Exhibition of last year, there were four columns entirely clad with mosaics. A very elaborate specimen of a column decorated with patterns introducing gold-ground mosaic has been lately put into the museum at Naples, and in the house of the greater fountain, and of Medusa there are noble fountains with "conchæ," thoroughly well enriched with mosaics. Pompeii was overwhelmed in the year 79; and therefore in the interval between that date and the time of Constantine,—about 330—a very considerable progress might have been made in the art, especially at a period when richness was sought for rather than beauty. From these and other facts it is perfectly clear that the Romans had an immense number of workmen perfectly competent to carry out works in mosaic when Constantine removed the seat of empire to Byzantium. One fact may be mentioned strongly corroborative of this view; namely, that at Rome, whoever wishes it, may find them himself, or have shoals of fragments of gold mosaic brought to him. The poets allude to it frequently, and it is clear beyond all question that the *vitreæ parietes* were essentially Roman.

When Constantine went to Constantinople, he took a certain number of work-people with him, but perhaps not the greatest number of those who worked at Rome; and even up to the time of Sta. Sophia I believe the mosaics were worked by the regular descendants of the Roman mosaicists, and not by Greeks. We may indeed state broadly that up to the year 500, almost all the churches in Italy were decorated by Roman mosaicists, and after that time by Greek artists. The oldest example of all is Sta. Costanza, the funeral chapel built by Constantine for his sister, adjoining the church of Sta. Agnese at Rome, and there we find the subjects of the Catacombs reproduced. The colours are black and white, as in the remains of the baths of Caracalla, and the subject is a large vine, trailing over a "pergola" or frame-work, and between the branches are genii eating the grapes. The meaning of this is of course the faithful living on the benefactions offered by the church. It is a subject of frequent recurrence in the Catacombs. I need scarcely observe that angels were not depicted till a later period, and the angelic idea was therefore expressed by children, or *amorini*.

It may be desirable, before I proceed, to recall some of the subjects of the Catacombs, because, as I have already observed, they gave the first tone to all the early Latin mosaics. The Christians of the first three centuries in their shelter in these caves, were afraid to express openly the doctrines which they held, they therefore veiled or concealed their sufferings, preferring to proclaim rather their faith in the happiness that awaited them. Thus we find the idea of the Saviour is expressed by a representation of Orpheus winning all to him by celestial music. Again we have him as the Good Shepherd with his sheep, or disciples; we have representations of a large cup with birds drinking from it, indicating the faithful receiving the sacrament, and stories from the Old Testament, all of which find their counterpart in circumstances connected with our Saviour, but there is no direct representation. Where the resurrection is expressed, it is frequently under the image of the raising of Lazarus, or the escape of Jonah from the whale's belly. Everything is expressed under a symbolical form, and Christ himself is represented invariably "imberbis," and arrayed with eternal youth.

There is no doubt the early Christians followed these types for some time; hence the number of representations of the cross, the vase with birds drinking, green fields with sheep feeding, &c., which are constantly found in all the Latin mosaics.

After Sta. Constanza, there is a considerable interval, till we come to the Church of Sta. Agatha at Ravenna, A.D. 400. Then there is Sta. Sabina at Rome, A.D. 424, where the mosaics formed a series of portraits in medallions, quite after the antique, going round the triumphal arch, (which was the great arch in the basilica, somewhat in front of the bema), and upon that were usually placed representations from the Apocalypse. That practice prevailed from about the year 400 to about 800.

The principal mosaic however which remains to us of this early time is that of Sta. Maria Maggiore, executed in 432. The mosaic over the triumphal arch contains the usual apocalyptic subject, supported right and left by a series of biblical compositions, and along the sides of the church, under the windows, is a series of subjects from sacred history, in which the whole of the figures recall very forcibly those of the column of Trajan, as best known to us in the engravings of Pietro Santo Bartoli. The whole of these are completely Latin in the mode of drawing and design, and as purely classical as the drawings in the Florentine Homer and the Vatican Virgil. It is in fact debased Roman, both in form, colour, and mode of working; and, as Lord Lindsay remarks, none of the compositions became traditionary in Greek art.

At the same time as this work of Sta. Maria Maggiore was carried out, the great mosaic of S. Paolo fuori le mura was executed under the auspices of Honorius, son of Theodosius.

About 440 Honorius removed the capital of Italy to Ravenna, where his sister, Galla Placidia, who was a very devout woman, (or paid largely for the credit of it), built and endowed many religious edifices; and we find an interesting and curious series of churches. The most interesting is the Tomb which she built for herself, her husband, her brother, and her son. It is a sort of cruciform building, with four arms, projecting in the form of a Greek cross. The subjects of the mosaic decorations are symbolical, and similar to those in the catacombs; one of the leading subjects being Christ feeding birds and lambs. These I believe to have been purely Latin works.

There is a Baptistery at Ravenna, the mosaics in which are similar to these at Sta. Sophia. We have in the summit of the dome our Saviour with John the Baptist, and beneath all the Apostles stand around. In the time of Placidia, or of her successor, Theodoric, who took Ravenna, churches were begun which were interrupted by the conquest under Justinian. From that date, 553, that monarch caused an exceedingly interesting series of mosaics to be carried out at Ravenna, corresponding of course closely with those of Sta. Sophia.

The most important Latin mosaic is one executed in the Church of S. S. Cosmo e Damiano at Rome about two years before Sta. Sophia was begun. It is probably the largest and most elaborate of all the Roman mosaics; and there, it appears to me, the Latin power spent itself; since in the next century we meet with scarcely any instances of mosaic works executed in Rome. It appears probable that the great works of Sta. Sophia and of the Imperial Palace, in the first instance, and of the church of S. Sergios (which is similar to and cotemporary with S. Vitale) and the churches executed at Ravenna, engrossed the labour and energy of all the principal mosaicists; drawing from Italy all the best artists, and retaining them for generations in the Imperial service, until indeed the Latin spirit died within them, and they became transformed into Greeks outwardly and inwardly.

The details are too long to go fully into, but I may mention generally that in the early Latin works the shading is marked by tints, and not by lines. In the later works produced by Greek artists we recognise a singularly liney manner. In the early specimens one part is lighter or darker than another, and forms are defined by a traditional chiaro-scuro, and not drawn as it were by an outline draughtsman. If we examine the MS. from Mount Athos, published by M. Didron, we find that the writer gives an account how the Greeks proceeded in their painting, and that it was done by a series of outlining and gradual painting in; precisely similar to what may be traced in the later Greek mosaics, and not in those done upon the Roman principle.

Now, in these churches at Ravenna, the most interesting of those executed after the mosaics of Sta. Sophia are the mosaics of S. Vitale, which are peculiar for containing two portrait representations on each side of the bema, or apse. On one side stands Justinian, attended by Maximian, the high priest, who brings offerings to the Church. On the other side is Theodora the Empress, advancing with her attendants on the same errand.

There are two churches of S. Apollinare at Ravenna, the one "di Fuori," and the other "di Dentro." The former is the earlier of the two, and contains more symbolical representation than any Greek mosaic I have seen. It seems (when contrasted with the mosaics of Sta. Sophia) that on Greek ground the designs of the Greek artists were simple, but that when they came under Latin influence, they became more complex and symbolical in their modes of representation. This is especially the case in the Greek mosaics executed in Rome during the Iconoclastic troubles; the subjects having no doubt been prescribed by the Latin Clergy. One of the most beautiful subjects in S. Apollinare di Dentro is a row of Saints under the windows of the nave. At the west end of the church is shewn the Palace of Justinian, and on the opposite side stands the part of the town called "Classe," and these figures seem to march in a grand line towards the east end of the church. On the women's side, terminating the composition, is the Virgin Mary, with our Saviour in her lap, and opposite her, our Saviour seated in glory. Of course this representation of the Virgin is curious, because it is one of the very earliest that exists of a subject which ultimately became exceedingly popular. In the Council of Ephesus, A.D. 431, the Virgin was for the first time allowed to be depicted holding the Saviour in her arms; and this is one of the earliest appearances of her figure after that edict.

Returning to Rome;—we left off with the mosaics at S. S. Cosmo e Damiano (executed about two years before the building of Sta. Sophia); and from that time until about the year 620 hardly any mosaic was made in that city. Some were then executed at S. Lorenzo fuori le mura, at Sta. Agnese, and at the Oratory of S. Venanzio in the Lateran; but they are of minor importance, and it is clear that the great works were then going on at Ravenna, and in the provinces, subject to Greek rule,—the tendency in all these was towards direct representation, and adverse to symbolism, as is proved by the injunction of the General Council of Constantinople, A.D. 692, which authoritatively

prescribed the former, and abjured the latter principle. Thus for a time there was a lull in matters of art throughout Italy,—and then broke out the iconoclastic troubles,—about the year 700, which drove all the figure artists out of the Greek Empire. On the occasion of their spread throughout Italy, began what may be considered the great series of Roman mosaics, in the churches of Sta. Prassede, Sta. Pudenziana, S. S. Nereo ed Achille, Sta. Maria Nuova, Sta. Maria in Domnica, S. Marco, the Triclinium of S. Leone, and many more in the same style. They contain frequently a large representation of our Saviour, or of the Virgin Mary, as the principal figure, and sometimes a green field with our Saviour and his sheep; Apostles and Patron Saints stand side by side, with occasional recurrences of the earlier symbols,—the execution of the whole being rather liney than in masses.

Returning to Byzantium, we find that Greek art does not appear to have reasserted itself in the treatment of pictorial subjects till about 120 years after the publication of the edict against the image painters and makers. The Empress Irene found that the feeling of the people was in favor of a somewhat sensual indulgence in pictures and statues, and it was agreed at a General Council that paintings should be introduced, but not statues. A discussion of the subjects then began, and authority was given for a certain series, which are embodied in the celebrated "Menologion," one of the most valuable MSS. in the Vatican Library. All the sacred acts depicted are recognized by this as allowed to be painted, and they form the staple materials of ecclesiastical decoration throughout the Norman and early Teutonic periods, and all the middle ages.

After the close of the ninth century, during which almost all these great mosaics were executed in Italy by Greek artists, who found very little employment in their own country (the Greek Emperors declining in power) there was again a great lull till about the year 1100. It is true many Greek workmen were employed at Venice about 1020, going steadily on at S. Marco, till 1200 or 1300, both with carved stone-work and glass gold ground mosaics; but their early specimens in the eleventh century were very poor. At the commencement of the twelfth century came an after-crop of Greek art, the great example of which is in the church of S. Clemente, about which Lord Lindsay is so enthusiastic. As far as mechanical execution goes it is very beautiful—there are a number of little figures of animals and birds of all kinds very delicately executed, and quite reviving the manual dexterity of the best Roman time.

I need scarcely remind you that it was from these artists at Venice that the art of working in mosaic was acquired by Italian artists. Greeks were brought from Venice to decorate the Baptistery and the church of S. Miniato at Florence, and they became the teachers of the great Italians—Mino da Turrita, Andrea Tafi, Gaddo Gaddi, and others. Furthermore, I have little doubt that the processes of glass-working, which have made the glass of Venice so famous, were almost all derived from Byzantium.

In reference to these Florentine monuments it is curious to notice the occurrence in Tuscany of a peculiar kind of carved work, cut out with a drill and filled up with mastic, which has puzzled other travellers as well as myself to account for. It may be seen in the pulpit of S. Miniato, and is precisely identical with the carving of foliage, and the mastic inlaying I have pointed out as occurring in the arch spandrels of Sta. Sophia. It occurs also in the font in the Baptistery at Pisa, and I have seen it at Messina. Until I had an opportunity of looking carefully into the details of Sta. Sophia I was unable to find out whence it came, and I was of course pleased to recognise it.

In summing up the general artistic features of novelty presented to us in Sta. Sophia, there are four points (in addition to the great structural novelties) to which I would direct special attention. The publication of M. Salzenberg's detailed drawings and descriptions, if it has done no further

good, has at least made it pretty clear that we are indebted to these Byzantine Greeks and to the great impulse given by Justinian;—in the first place, for the introduction of all the processes of Florentine mosaic;—in the second, as I believe, for the introduction of stained glass into church architecture;—in the third, for the peculiar mode of sinking carved work beneath bounding lines of form;—and in the fourth place, for the liberties of direct representation of basket work and other novel features in the capitals and sculptured ornaments.

I shall now say a few words about the technical execution of these mosaics, to which I would specially beg your attention; because I see no reason whatever why we should not practise in the present day exactly what the Greeks and Latins practised of old. The dome, arch, or conch, was built with brick or stone, and rendered with rough plaster to make a key for subsequent coatings. Then a strong and fine plaster nearly an inch thick was put upon it. Cartoon or drawings were made, to assist in transferring the subjects to the wall, or they were drawn on the plaster itself;—then, beginning with the most important part, the artist knocked out with his chisel a piece of the plaster corresponding in size to that which would be occupied by a few tesseræ. He then went to the trays in the compartments of which the coloured glasses were sorted, and selected a piece of the vitreous material of the proper colour, which might be of the size of a circle 5 or 6 inches diameter and half an inch thick To cut this to a particular shape he used a particular apparatus. Placing the piece of mosaic upon a sharp edge of iron, and striking it with an edge tool exactly plumb with the under iron, he fractured it in a direct line between the two edges. This was the later method, but an earlier one was to draw a hot iron along the line in which it was desired that the material should be fractured. Having thus the small piece he wanted, the artist took some fresh cement (made of 1 part of lime with 2 of marble dust), inserted the piece, and pressed it till it was flush with the adjoining plaster, and he could see whether more cement was wanted, and how the mosaic was bedded; and so he proceeded till he had finished a face, or some other leading feature, when he left off to commence in another place, allowing an inferior hand to work upon the draperies, &c.

We may as well remark, that in the ancient mosaics the cement was made as above described. In the middle ages it was made with lime and travertine stone; and still later, where the work was very fine, and it was wished to retard the setting, lime and linseed oil were used, so that the mastic remained soft all day; and the mosaics might be eased as they were respectively bedded. There is one peculiarity of treatment which was universally observed; namely, if the artist had to execute a profile of any kind, all the longitudinal joints of the flesh would be parallel to the contour; but instead of the joints of the gold ground abutting directly upon the contour, they followed round it, parallel to those of the outer flesh colour series: the great object of *this* line of gold ground mosaic was to prevent any interference by the joint-lines of the general ground with the repose of the heads. An inferior workman, who had his cubes of gold ground mosaic ready cut to a rough square on the surface, then put them in as fast as possible. That completed the work, and it set, as we see, for ever. Could we but add up the sums which we pay for painting and repainting our monuments, I think there cannot be much doubt we should find that it would have been far cheaper to have executed our decorations in mosaic.

Some of the mosaics at Sta. Sophia have a peculiar character, which M. Salzenberg observed by the aid of the scaffolding for the repairs; namely, when the mosaics can only be seen from beneath, at an angle exceeding 45 degrees, the pieces are arranged with their upper edges set forward from the wall face in tiers, farther and farther apart, as the angle of vision is increased. By this means the work is saved on much intervening space, and both material and cost economised—

in some parts to the extent of two-thirds of the whole. This method had also the advantage of reflecting the light at a better angle to the eye.

These, I think, Gentlemen, are the principal technical points connected with mosaic in general, and Sta. Sophia in particular. The hands of the clock forbid my trespassing longer upon your time; but I must, in conclusion, beg you to attend for one moment to what I venture to call the moral of Sta. Sophia. I know of no monument which so satisfactorily and honestly answers the purpose for which it was built; or which so completely expresses in every way its construction and intention. By the exterior you perceive exactly what it is internally; there is no fudge, no sham, no concealment about it. Every material is fire proof; and one ever memorable fact about it is, that although Justinian sent out in all directions for the old materials of temples, precious marbles, and everything of the kind that could be found, I am not aware that there is any piece of old work used in its original state, throughout the whole building. If the artists who designed and executed Sta. Sophia were influenced by tradition, they were, at any rate, no blind copyists; they set a far nobler example to those who succeeded them then Constantine had to those who followed him;—would that the art of the nineteenth century in this country could stand the test of comparison as satisfactorily! Let us remember that it is only by equal truth, honesty of purpose, and originality, that we can ever hope to see realised the day-dream of a Sta. Sophia of our own.

Before sitting down, Mr. Wyatt added a few words as follows:—

I omitted to mention that I have here some specimens of the actual mosaics of Sta. Sophia, contributed by Mr. Scoles. Mr. Poynter has many of them. The old treatises (as I have already observed) contain descriptions of the mode of making them. One was to take a sheet of ordinary glass, about half an inch thick, and upon that to lay gold leaf, upon that again to spread a very thin sheet of pure crystal glass, and to put the whole into an oven and burn it into one mass. Another mode was to take ordinary clear glass, made (by the addition of a little more lead) fusible at a lower temperature; to pound it to a powder, and then to spread the powder over the glass mosaic, so as to produce a thin film; and I think that was the best way, as it is very similar to the lead glaze that we put upon common pottery. As a general rule, the older the mosaic the thinner the covering of crystal glass. We can almost tell whether it is early or late by the thinness and clearness of the covering. In Mediæval and Italian mosaics, such as those of Sicily and the Basilicata, the gold leaf is extended upon a common brown ware, of silicious quality, but unlike that of the ancients.

Mr. Wyatt concluded by offering to answer any questions which might be put to him upon the subject of his address.

The Chairman, Mr. Papworth, Fellow, observed, that an important element in the consideration of such questions as the present, was to ascertain where any particular practice came from, and what was the use of it. This Mr. Wyatt had done, and he had, moreover, illustrated the ethnological view of the subject in showing how different styles had grown by the intercourse of various nations. Thus it appeared that the artificers of Justinian were embued with an oriental feeling derived from Persia; and thus the decline of art, in consequence of the iconolastic persecution, had been referred to. He believed Mr. Wyatt had stated that the use of mosaic was a mark of a degenerating civilization; and he (the Chairman) would accept that observation literally as the fact; but if he had misunderstood Mr. Wyatt on that point, he should be happy to be set right. With reference to the contrast between the Classical and Byzantine principle of decoration, he believed there were instances in the former in which foliage, &c. had been cut out of, instead of being superadded to, the solid mass.

Mr. Wyatt admitted that it was so, as at Tivoli; but the rarity of the exceptions only rendered more positive the rule which he had laid down.

The Chairman observed that there was some doubt as to the identity of the Royal Gate in Sta. Sophia; and with reference to the *bema*, he drew attention to the fact, that the word itself, meaning originally a footstep or a pace, seemed to have been applied to anything that was elevated, as a platform; and not simply the *apse*, which he considered to be the better word. Then the *solea* was a very doubtful part of the building. One writer described it as the pavement at the entrance of the sanctuary, another a place between the bema and the ambo, another the place before the rails, and another (whom he considered the best authority), the throne of the emperor.

Mr. Wyatt said that he had merely used the word *bema* in connection with the Greek church, as he did the word *apse* in speaking of the Latin church.

Mr. Nelson, Hon. Sec., referred to the distinction between the bema, the apsis, and the solea, made by M. Salzenberg.

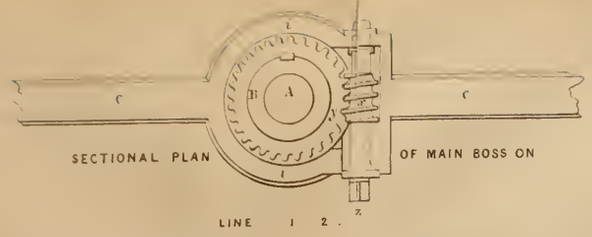
Mr. Jennings, Fellow, referred to the mosaic supposed to represent the figure of Justinian, and in reference to the circular nimbus around the head of that figure, inquired whether there were any other examples of the nimbus being placed upon the representation of a living person.

Mr. Wyatt said that in mosaic representations which were known to represent Justinian, as at S. Vitale at Ravenna, there was a circular nimbus. The square nimbus usually appeared on representations of living persons, and the round nimbus was generally reserved for apotheosis.

Mr. Scoles, Hon. Sec., remarked that sunk carving was common in Egyptian art, and it might be possible that Justinian's artists derived the practice from that source.

Mr. Wyatt observed in relation to the diffusion of Byzantine art in later times, that it extended to Georgia, Armenia, and more particularly to Russia. He referred to a print exhibited by Mr. Donaldson, from a picture in the Cathedral of Kazan, of the Madonna and Child; which was almost identical in style with the arrangement approved of by the Council of Ephesus. Kazan, he stated, was after Kiew and Moscow, one of the oldest places in Russia (and now celebrated for its trade in leather boots); the cathedral was entirely Greek in arrangement.

The Chairman proposed the thanks of the meeting to Mr. Wyatt for his valuable and interesting observations, and, the vote being carried by acclamation, the meeting adjourned.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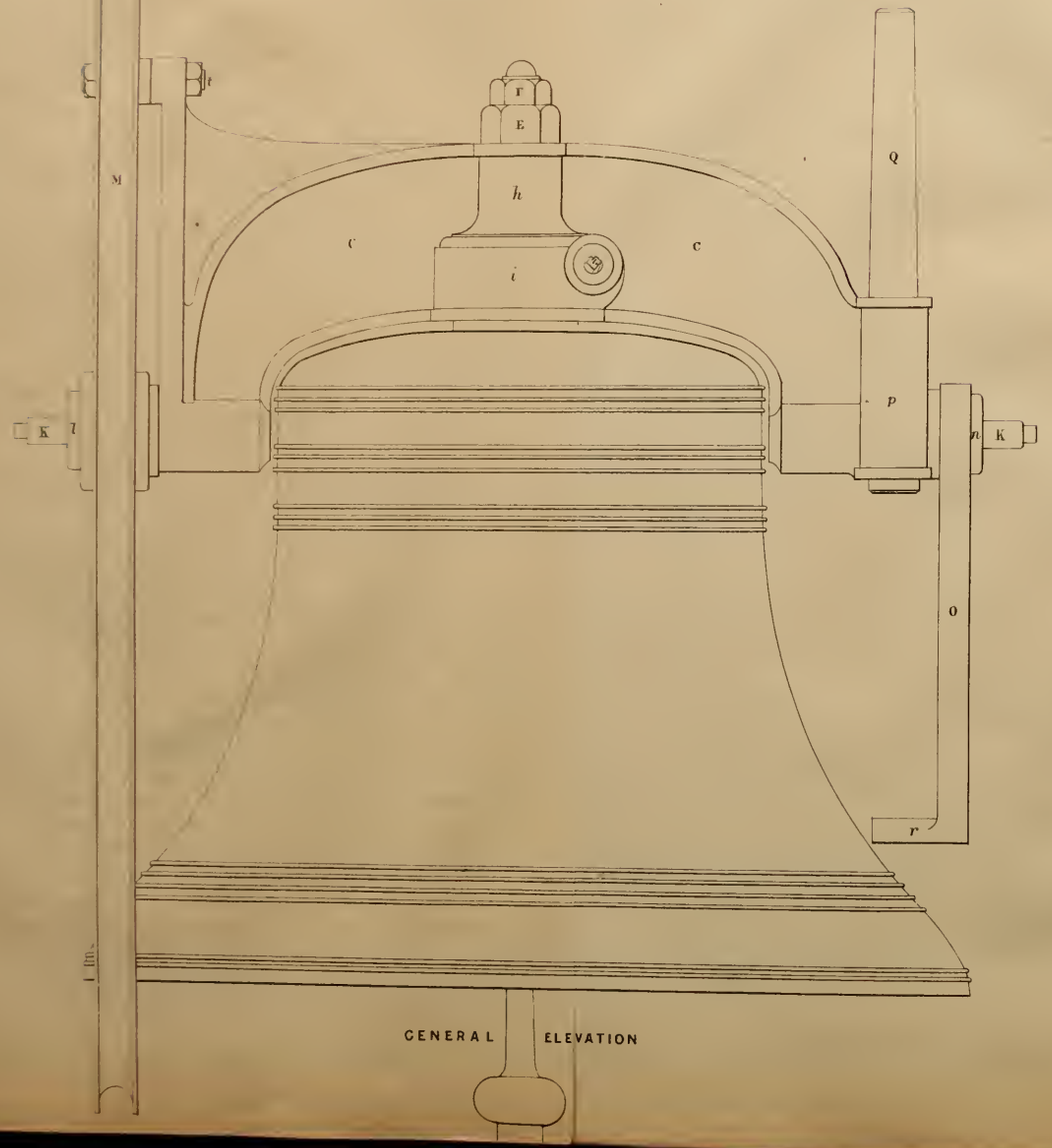
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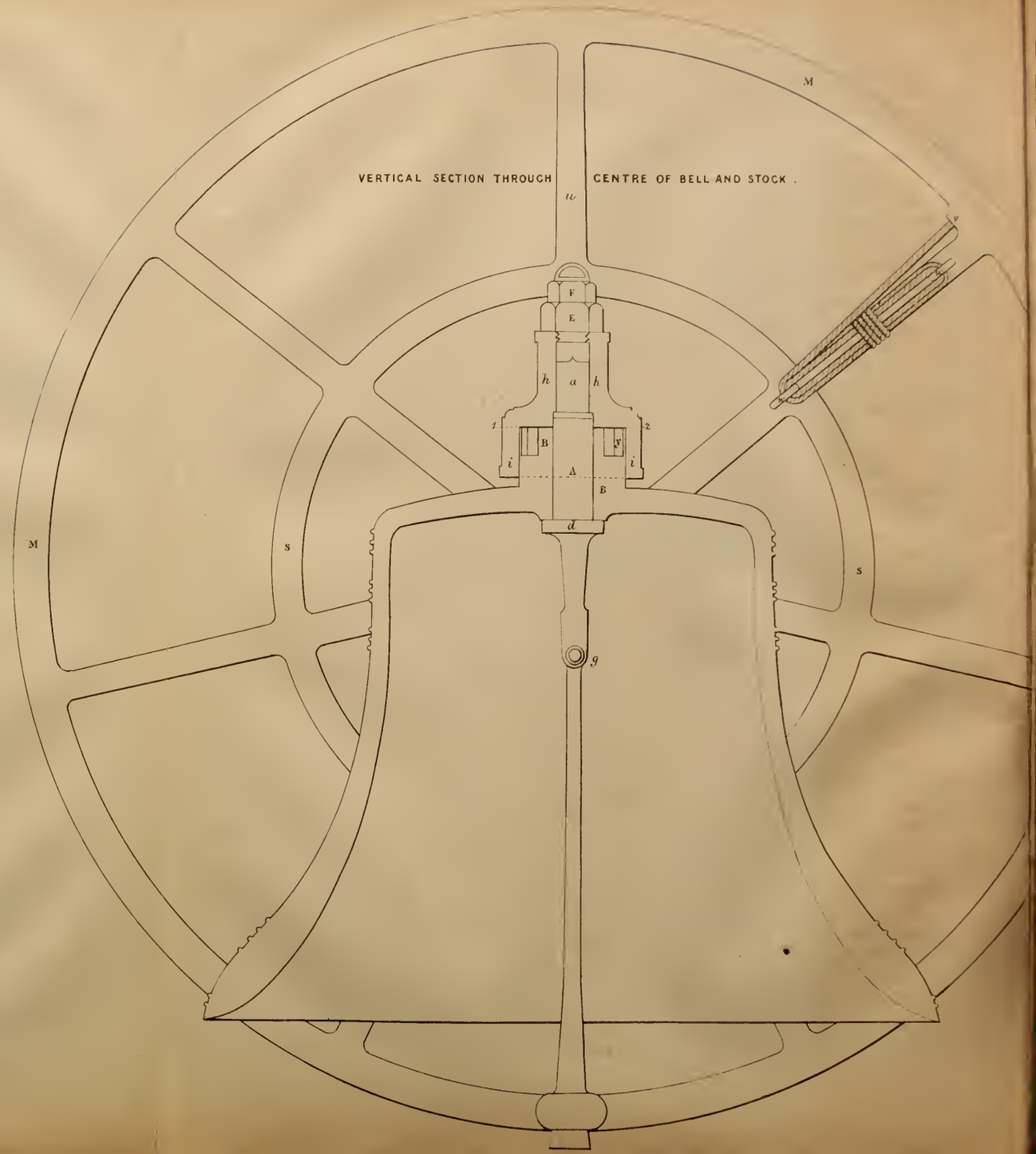
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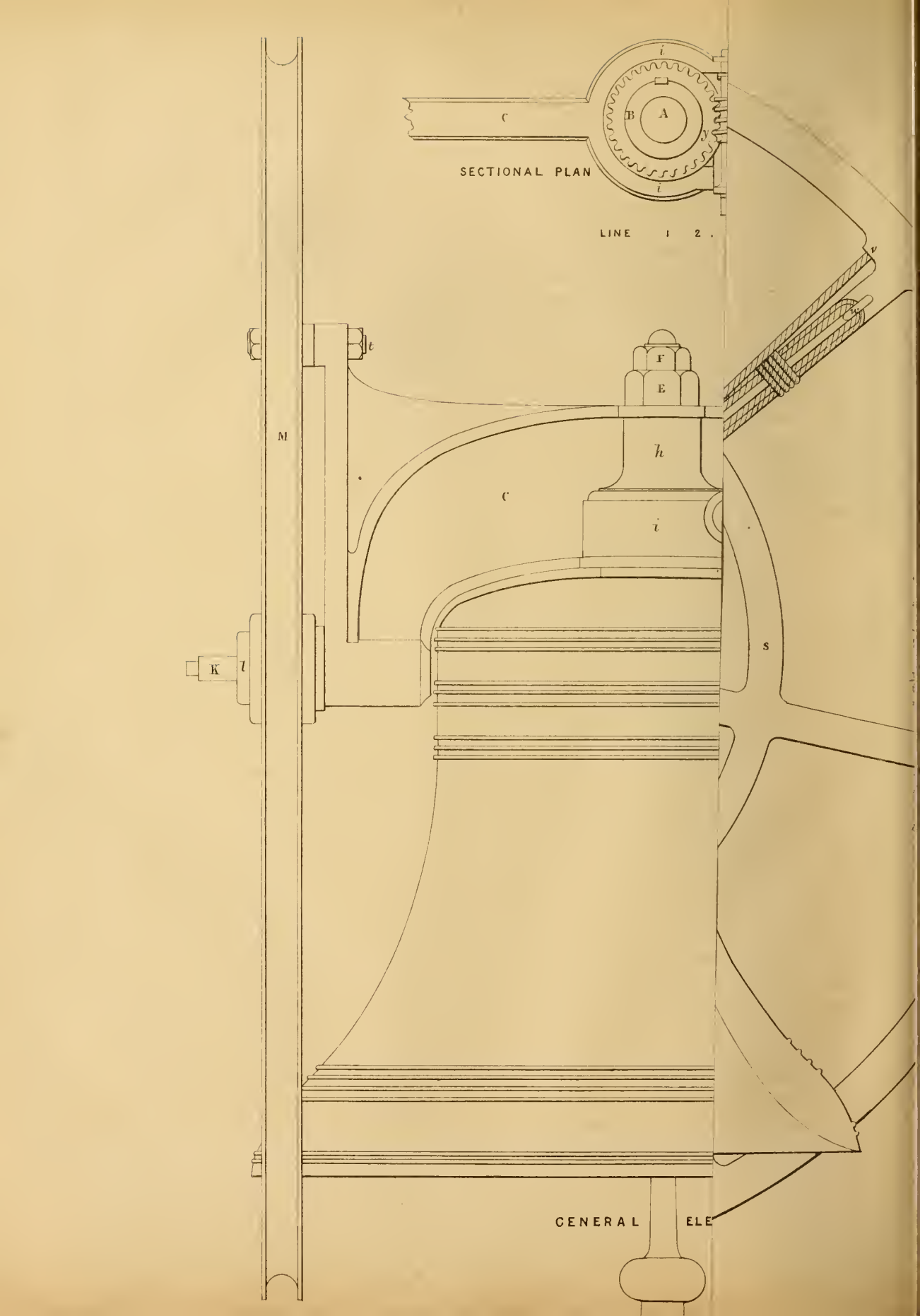
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A DESCRIPTION OF SOME ALTERATIONS IN BELLS, AND BELL MACHINERY.

By W. L. Baker, C.E.

Read at the Ordinary General Meeting of the Royal Institute of British Architects, March 5, 1855.

Before commencing this subject, I wish to observe that the alterations to be described were planned for the purpose of improving, and not of radically changing the existing system of bell mechanism; and that they are not intended to supersede the athletic exercise of bell ringing, but on the contrary to furnish the ringer with a more perfect instrument. They will at the same time render bells, which are very expensive articles, much more durable, simplify their gear, and render it more impervious to the inroads of time and weather, and less liable to derangement. The art of bell-hanging, simple as it may at first appear, involves more theoretical investigation and more practical knowledge than perhaps those who have not studied the subject, or had practical experience therein, can be aware of; but the alterations I have to propose are the results of observation and practical experience, gained in the ringing-room and in the bell-chamber. Before entering upon the particulars of the alterations, it will be desirable to describe the principal features and details of the ordinary system of bell machinery, the uses of its various parts, and the manner in which a bell is rung.

A bell hung in the ordinary way for ringing is suspended from, and firmly secured to a wooden beam called the stock by means of long iron links; the lower ends of these links are attached to ears technically called cannons, cast on the crown of the bell, or to cross-bars passing through the eyes of the cannons; the upper ends of the links, which are screwed, are passed through iron clamp plates bedded on the top of the stock, and are secured by nuts which are screwed with the aid of a spanner down to the clamps, until the tops of the cannons are pressed firmly up into a recess cut in the under side of the stock, so as exactly to suit their shape. The length of the stock is generally about two or three inches more than the diameter of the mouth of the bell, in order to give clearance between the skirt of the bell and the framing. At each end of the stock, and at the lower part of it, is fixed a pivot or gudgeon, which rests and turns in a brass bearing fixed in the framing. A large rigger wheel is attached to the stock, and by means of a rope connected with a particular part of the periphery of this wheel, a ringer is able to put the bell into a state of oscillation. After a few primary impulses a firm stroke is given to the bell by the clapper just at the completion of each arc of the bell's oscillation. The impulses being continued by the ringer is technically called raising the bell, because the centre of gravity of the bell at every successive impulse describes a larger arc, and at the termination of every oscillation is raised to a higher point than it had previously attained, until the arc of oscillation becomes a complete circle, and the bell is brought, at the termination of each oscillation, into a position of stable (?) equilibrium, the mouth of the bell being upwards. By allowing the bell to pass a little beyond the vertical line, the ringer is able to hold it in a state of rest. This is called setting the bell. When this has been once accomplished, an expert ringer is able, with very little effort, to pull off his bell again with just so much force as will make it retrace its path and ascend on the other side, until it arrives again in a vertical position, and he can set it at every oscillation, and consequently at every stroke of the clapper. The bell is thus in a state in which he has a considerable control over its movements, for although the ordinary oscillations of the bell are nearly isochronous, he can shorten and accelerate them by checking the rope, lengthen and render them slower by giving the bell more rope, or stop them altogether by setting the bell; and these various alterations in its movements may be made with a moderate amount of exertion on the part of the ringer, because the impulses necessary to produce them are given at the commencement, or near the termination of the bell's oscillations, when the

vertical distance through which the centre of gravity of the bell passes is much shorter than the horizontal distance. Change-ringing could not be accomplished without the control which is thus given to the ringers over the movements of their bells. In simply ringing a bell after it has been raised, the only resistance to be overcome is that of the air acting upon the moving bodies of the bell, wheel, and stock, and the friction of the gudgeons, and although these resistances are scarcely felt by the ringer in ringing a well hung bell for a few strokes, they begin to tell upon him if he continues ringing some time. One object therefore to be aimed at in hanging a bell, is to reduce these resistances as much as possible. The stay is a simple adjunct to a bell's gear, consisting of a vertical bar of wood attached to the stock, and projecting somewhat above it. When the bell is set, the extreme end of the stay comes in contact with a moveable stop attached to the framing, which prevents the bell from overturning, and eases the ringer of the trouble of holding his bell when set.

I have thus briefly adverted to the principal features of a bell's gear, their uses, and the way in which a bell is rung, in order to be able to explain more clearly the alterations now to be described.

Instead of the cannons mentioned before, a strong circular boss, B, concentric with the vertical axis of the bell, is cast on the crown, and in place of the links and clamps before described, a single bolt, A, with a thread and nut, E, at the upper end, is used for the purpose of securing the bell to the stock; this bolt is passed up through the centre of the boss, B, and the stock, C, till the collar, *d*, forged on the bolt, comes in contact with the underside of the crown of the bell; the nut, E, is then screwed down upon the top of the stock, and the top of the boss, B, brought thereby into firm contact with the stock to which the bell is thus securely fixed. When the nut, E, has been screwed firmly down, the check nut, F, should be screwed down tightly upon it; this will prevent the nut, E, from unscrewing, a frequent occurrence in machinery in motion where check nuts or keeps have not been provided. The lower end of the bolt, A, is prolonged sufficiently and formed into a joint, *g*, to carry the upper end of the shank of the clapper. The stock, C, instead of being made of timber, is cast in iron. It has a central boss, *h*, to receive the main bolt, A, and the lower part, *i*, of this central boss is sufficiently enlarged to receive the bell's boss, B, so that the lower edge of the stock may be brought down to within an inch of the crown of the bell. The two gudgeons, K K, are securely fixed in the ends of the stock by being turned to fit slightly tapered holes, into which they are tightly driven and fixed by their inner ends being rivetted over or pinned in; the stock with the gudgeons fixed in it, is then put into a lathe, and the gudgeons turned accurately true to one another, both as regards their diameters and concentricity; at the same time the end, *l*, of the stock is turned to suit the hole in the central boss of the rigger wheel, M, and the other end, *n*, is turned to enter the eye of the catch, O; a socket, *p*, is cast in the stock to receive the lower end of the stay, Q. When the bell is set, the upper end of the stay rests against the tail, *r*, of the catch, O, which itself rests against a stop on the framing. The rigger wheel, M, is of cast iron; it has seven arms, and an inner circle, S. It is put into a lathe, checked truly, and then the central boss is bored out. It is attached to the upper part of the stock by a bolt, *t*, passing through a boss at the intersection of the inner circle, S, and the vertical arm, *u*, and a corresponding boss on the stock. The rope passes through a hole at *v* into the groove of the wheel; *w w* are hooks attached to the wheel, upon which the ordinary quantity of surplus rope may be wound. This completes the description of my alterations in bells and their gear. The small and simple apparatus which remains to be described is an addition to the ordinary gear of a bell, and consists of an endless screw, *x*, fixed in a boss in the stock, and made to gear into a toothed wheel, *y*, keyed into the central boss, B, of the bell. The outer end, *z*, of the endless screw's spindle is made square to receive a spanner or wrench with which it may be turned by hand, and through the medium of the toothed wheel move the bell round horizontally on its vertical axis, in order

to present a fresh part of the sound-bow to the wear occasioned by the clapper. The main bolt, A, forms the vertical axis, and is prevented from turning with the bell by being made square at the part, *a*, in order that the joint, *g*, of the clapper should always be in the same plane with the gudgeons. The following advantages are obtained in this system of hanging bells.

To cast a central boss is a much more simple operation than to cast cannons on the crown of a bell, as the latter are complicated and expensive to mould, and without care are liable to turn out faulty. The method of attaching the bell to the stock is rendered much more simple by using one main bolt, instead of six to ten links, with their necessary nuts, clamps, and cross-bars; one large bolt is also more secure than a number of small ones, which, in all probability, will not all be screwed up equally tight, and consequently there will be a greater strain on some than on others. The stock of a bell, which is generally more or less cranked, has to stand considerable strains and counter strains, and when made of timber, the bell and wheel are attached to it by iron bolts and fastenings. To insure sufficient strength, it is therefore necessary that a tough and hard wood should be used. Elm, possessing these qualities to a greater extent than any other available wood in this country, is that most approved of for the purpose. But elm is one of the worst woods for swelling, shrinking, and warping, when exposed to variation of temperature and moisture, the consequence is that, as the summer advances, all bolts and iron fastenings connected with the moving gear of a peal of bells get loose and require tightening up. The gudgeons also being let into the stock, and bolted to it, are consequently thrown out of truth, and this cannot be permanently rectified in a wooden stock. The Reverend W. C. Lukis, in his paper on bells read before the Wilts Archæological Society, on the 13th September, 1854, very justly observed,—"Bells require very constant attention to keep them in proper ringing order; when you consider their enormous weight, the different parts of their harness, the iron and wood of which it is composed bolted and screwed together, the frame-work on which they hang, and which in revolving they violently shake and vibrate, and then reflect that the iron and the wood are both exposed to continual changes of atmosphere, when one of those materials expands the other contracts, and that then the bells cannot oscillate so easily, you will form some idea of the care and attention they require to keep them in ringing order." But all the defects which thus attend the use of wooden stocks and wheels are completely and effectually remedied in properly constructed iron ones, because the whole of the moving gear is then made of the same material, the various parts of it expand and contract equally, and when they have been once properly secured and bolted together, they remain so under all circumstances of temperature or moisture. Cast iron stocks have great rigidity, and are not liable to warp. The variations caused in them by the extreme temperatures of winter and summer are exceedingly small, and the expansion and contraction is always of a regular nature, so that neither the gudgeons nor any other parts are ever thrown out of truth. Cast iron stocks have the further advantage of rendering the gudgeons capable of being simply and firmly fixed, and accurately turned, and their lateral surface is about four-tenths of that presented by wooden ones, and they consequently offer a proportionately less resistance to the air when the bells are being rung. The advantages therefore of the exclusive use of iron as the material for the moving gear of bells, are greater rigidity and durability, gudgeons permanently true, and a reduction of atmospheric resistance. A peal of bells would also be rendered fire-proof by the further addition of iron framing.

It is well known by those who are conversant with the subject, that the clappers of bells, by constantly striking the same parts of the sound-bow, wear two indentations, which may be found oftentimes three-quarters of an inch deep or more in bells that have not been cast more than from thirty to fifty years. These indentations must necessarily weaken a bell considerably in the very part

that has to sustain the blows of the clapper. It is not uncommon in examining large bells to find that it has been thought prudent or necessary to quarter them, that is to turn them horizontally one quarter round, in order that their clappers may strike fresh parts of the sound bows at right angles to those they previously struck. This alteration is attended with much trouble and expense, for the following reasons :—First, the cannons are cast to suit properly only one way of fixing the bell to the stock, so that when the bell is turned one quarter round, it is not so convenient to attach the links and fastenings, and the recess in the stock has to be refitted to the cannons. Secondly, the iron links and fastenings require alteration. Thirdly, the iron staple from which the clapper is suspended, being cast in the crown of the bell, is consequently moved round with it, and therefore it is found necessary to bolt an extra piece to it so as to form a new joint for the clapper, at right angles to the old one. After all this trouble quartering is at the best an incomplete remedy, because it presents a fresh part of the sound bow to be also beaten into holes by the clapper. But when a bell is hung upon one central bolt which forms a fixed axis upon which it may be moved round, quartering is no longer necessary, because by turning the screw provided for the purpose, a man can at any time with great ease present any part of the sound-bow to the action of the clapper. Thus by proper attention the clapper, instead of producing two deep indentations and ultimately cracking the bell, may be made to wear the whole circumference of the sound-bow equally throughout, and thereby maintain an equality of thickness in the most important sounding part of the bell.

A properly cast bell would, under these circumstances, be exceedingly durable, because the whole circumference of the sound-bow must be deeply worn by the clapper before the bell would be seriously weakened and rendered incapable of sustaining the blows of the clapper without injury. A new bell is said to improve in its quality of tone after it has been hung and had a good ringing, the reason assigned is that the blows of the clapper condense the metal. Now this condensation can ordinarily take place in two points only of the sound-bow, therefore we may expect that when we are able to give the bell a good hammering all round with the clapper, the sound will be still further improved.

I have now described my alterations in the ordinary system of bell machinery, and explained the advantageous results which I consider them capable of producing, and which I believe they will be found to realize.

Although clocks and watches now abound, bells continue to be public favourites; they are still chimed to call us to church, and are rung on joyous occasions; new peals of bells are being constantly cast, and old peals recast with additional bells. No new Church is considered complete without bells, and much trouble has been taken and expense incurred in providing the Royal Exchange with bells and chimes. Thus bells are cheerful and harmonious adjuncts to our cities, towns, and villages. But the bell is also to be found at the dreary and secluded lighthouse station, where it is rung or tolled in foggy weather when the lights are no longer visible. A large bell is frequently fixed in such positions, and at the entrances of harbours. There is a very fine bell at Kingstown Harbour, connected with one of the lighthouses at its entrance, and Messrs. Mears have recently fixed one on the magnificent but dangerous rock, called the South Stack, at Holyhead; this bell weighs forty-two hundred weight, and with its gear and self-acting ringing apparatus forms an important addition to the machinery of the Trinity Company's lighthouse which stands on that rock. A bell so placed and used is a powerful agent in the preservation of human life.

While the value of bells is thus universally acknowledged, it is hoped that any invention, the object of which is to facilitate their use and increase their durability, will receive a favourable consideration.

The Chairman, Mr. Hussey, Fellow, invited remarks from any gentleman who might have paid attention to the subject of bells.

Mr. E. B. Denison, Q.C. Visitor, said that he had been a bell-ringer for many years, like a very famous member of his profession, Sir Matthew Hale. The only publications on bells which he knew of, merely touched the fringe of the subject; and, judging by the results, it seemed to him that the modern bell-founders knew less of their art than the old ones. It was well known that not one of the very large bells which had been cast in England within this century was considered equal to the Old Tom of Lincoln, or even to St. Paul's bell; and at the Royal Exchange not only one but two successive peals of bells had been condemned by the public ear, and they had now been again recast by another founder, although they had been approved by musical referees. But musicians did not necessarily know what bells ought to be, though they could of course tell if they were in tune with each other; but a set of cast-iron saucepans might be made in tune. He believed that architects might do something towards the improvement of bells, as they no doubt often had the management of them, if they would select bell-ringers in the neighbourhood to approve them before they were certified and paid for as perfect. He had been consulted by the Board of Works on the recommendation of Sir C. Barry, with reference to the bells for the great Westminster clock, which had been made from his designs; and it was proposed to have the bells, of which the largest would be 15 tons, cast under the superintendence of himself and the Rev. W. Taylor, who had paid great attention to this subject, and from whom he hoped they would hear something to-night. But the Board had now declined any further assistance from them, because they refused to have the Chief Commissioner of Works associated with them, knowing that his interference could not possibly be of any use, and might at any moment become obstructive. This was one more specimen of the way in which Government Boards did their work in small matters as well as in large. In answer to a question from Mr. Donaldson, Mr. Denison said that bell metal held a mean place between the speculum metal of telescopes, which was a saturated compound of copper and tin, and excessively hard, and gun metal; bell metal having about three of copper to one of tin, and gun metal having still less tin in it, The proper fusion of the metals so as to avoid *burning* the tin, was a matter of primary importance, and where it was not properly managed the bells would be porous and utterly bad, as some of the late Exchange bells were, though a few of them were as good as need be. He had long been struck with the want of uniformity, both in the hardness and the shape of bells, even in the same peal. Messrs. Warner of Cripplegate, the well known brass founders, had lately taken up the trade of making church bells, of which they had three in the Great Exhibition. Since then they had made some considerable improvements, and were able to avoid the *sand-cracks* which were a common defect. They had also made some experiments on different forms and thicknesses, at his request; and he was now satisfied from those experiments that bells, especially large ones, were generally made too thin in the *sound-bow*, and always too thick in the *waist*, for getting the best sound out of a given quantity of metal. He hoped soon to arrive also (if he had not done so already) at a definite result as to the best form or *sweep* for bells. Those approaching the flower-pot form were always bad, and so were generally those of which the height was much more than three-quarters of the diameter. Many of the Italian bells were of this long form, and he understood that they were almost invariably bad.

With regard to Mr. Baker's patent improvements in hanging, and in answer to a question from Mr. Papworth, Fellow, Mr. Denison said he had understood that the bells in one of the churches at Liverpool were hung on a cast-iron frame, but that it was not considered successful. Nevertheless he saw no reason why it should not be, if properly made. Bell frames were usually made on the most absurd principle, of what the bellfounders' carpenters call balancing the swings, which they fancied was to be done

by making some ot the bells swing at right angles to the others—the position in which any counteraction was impossible, and the effect was that the bells were always trying to twist the frame to pieces. He had himself designed the frame for the large peal of bells cast by Messrs. Warner for the Cathedral at Fredericton in 1852, as to which he had been consulted by the Bishop. The carpenter violently objected to making the model which was to be sent out; but *his* plan was followed, and he had heard no complaints of its unsteadiness; on the contrary, the peal seemed to give great satisfaction in all respects. He need not tell the architects present that the bell-frame itself should not rest on or butt against the walls of the tower, but be laid on the floor, of which the main timbers should be braced together, either by strong floor boards or otherwise, so as to be as stiff as possible. In this way the bell-floor for Doncaster church had been designed by Mr. Gilbert Scott, the architect, and himself (he being one of the committee for re-building that church). He could not at all approve of Mr. Baker's plan of hanging a large bell by a single bolt through a hole in the crown, and would be sorry to stand under such a bell to ring it, as the strain was then six times what it was when stationary; even if the bolt itself stood, he thought it not at all unlikely to tear the crown out. The object of presenting a new part of the bell to the clapper might be obtained much better by casting the bell with a broad and low neck with a flanch all round it, instead of cannons, to which as many bolts as thought fit might be attached, going through the stock, and the clapper might be hung from a bolt through the crown and stock, fitting with a square into the latter, like Mr. Baker's plan in that respect, but quite unlike it in regard to carrying the weight of the bell. The toothed wheel and endless screw (even if the other part of the plan was unobjectionable) were quite out of the question on the ground of expense alone, and would not be the least more effectual than the plan he now proposed; the latter might take an hour to do, while Mr. Baker's bell might be turned to a new place for the clapper in a quarter of an hour; but inasmuch as a bell would certainly not require to be shifted above once in twenty years, that difference in time was not very material. He did not however at present see any objection to cast-iron stocks, except that they would be heavier and dearer than wooden ones; and there was no material shrinkage in the latter after a few years, especially if painted or otherwise prepared. He thought it was a mistake using elm instead of oak for them. Cast-iron wheels he thought quite an unnecessary expense; and the lighter the wheel the better, because the less momentum it had. He agreed with Mr. Baker that the *sliders* were very commonly made so as to occasion unnecessary friction in ringing. But he had himself altered the sliders of a peal of bells which he used to ring above twenty years ago, by making them run in circular grooves struck from the gudgeons of the bell, and this produced just the same effect as Mr. Baker's more complicated plan, and if a slider was broken by a young ringer, it only used to cost sixpence to put in a new one, as they need only be sticks, and not pieces of carpentry, when made to run lightly.

Mr. Papworth, Fellow, called attention to the cross-bracing of the iron bell-frame shown in the model, and asked how it was intended to be applied to a number of bells in one frame. He also alluded to the question whether the clock should be placed above or below the bells to escape the effects of vibration.

Mr. Denison would answer the latter question in a moment. Where there was a large peal of bells, the tower was almost certain to vibrate when they are rung; and in that case the lower the clock can be put the better, for a steady support was essential to its accurate performance.

Mr. Baker defended his proposed method of hanging bells. The central bolt might be made strong enough to resist any strain thrown on it, by taking the precaution of using the best materials. After a long spell of ringing a ringer would be convinced of the advantage of his proposed method, as the gudgeons remaining true and the stock not warping, there would be no extra friction to cause

extra labour. The wheel of a 30 cwt. bell would be 8 feet in diameter, and might be hauled up to the bell chamber through the louvre windows. The center to receive the gudgeon would be turned out to shape, the rest of the wheel would be an ordinary casting in iron. He did not think that any cross bracing in the lower horizontal parts of the cage, as mentioned by Mr. Papworth, would have any effect in regard to the lateral thrust on the tower.

Mr. Ashpitel, Fellow, had paid much attention to bells on the Continent, especially in Italy, where they are generally much taller and tumble in more at the top than in this country. A long lever projected at right angles from the stock, to which a rope was attached for ringing them, though they were rather chimed than rung, as they were raised but little in the operation. A good specimen might be seen in the leaning tower at Pisa. The cannons on the crown were higher than in English bells, the opinion in that country being that the more independent the bell was of the stock the better the tone. If this was the case, it would be better to suspend the bell from one long boss, than from several straps screwed up to the stock. At Rome he had observed that the clapper was so hung as to have some play round the sound bow, and not to strike always on the same point. The extra thickness usually given to the sound bow might have been a provision to allow for chipping away the metal in the old method of bringing them to the proper tone—[Mr. Denison, No.]—but this operation was now accomplished by turning them with a lathe. Mr. Ashpitel's practice in hanging bells was to fix strong stone corbels in the walls of the tower, on these corbels he placed the main girders quite free of the wall, with a space of one inch or more allowance for play, on them the floor, and on the floor the bell frame or cage, but not fixed to it, so that each of these parts might move independently of the others. The theory of vibration, that a bell struck became changed from a circular to an oval shape in producing a musical sound, might, he considered, apply also to the tower. He would therefore advise that the tower should be constructed to allow for this change of form; let it be built solid in itself, an homogeneous mass of wall all round, but without any cross bracing or strutting to resist the vibration. There might be some difficulty in getting an iron wheel into belfries, but the ordinary wooden ones were easily taken up in pieces. He had some hesitation in trusting to cast iron for the stock and gudgeons, having seen instances of the sudden manner in which failure took place in that material. As an instance of a tall-shaped bell, he would mention the great bell at Canterbury, which was known to travel well.

Mr. Baker explained that the gudgeons in his method were of wrought metal, inserted and secured to the cast iron stock.

Mr. C. H. Smith, Visitor, believed that all bells must, from their crystalline nature, sooner or later become cracked, even though they might last 500 years before the failure took place. He would submit as an interesting problem—find the best shape to produce, from a given quantity of material, the best sound without liability to fracture. He would advocate striking the bell quietly in preference to swinging it to produce tone. Harmonious sounds might be produced even from lumps of metal, or rock, nowise fashioned to a bell shape.

The Rev. Wm. Taylor, Visitor, agreed with Mr. Smith that the best shape for bells was not yet known. Even lead cast in circular shape would yield a sound. But he could not agree as to striking bells quietly, for they always sound better when swinging than when struck without moving. Much difficulty attended the mathematical investigation of the subject. So many data were required—but there were many rules which came practically near to the truth. In the composition of the metal, great care was required that it should not be overheated, as, in that case, the tin would be driven off. He had seen many of the large bells on the continent. That at Erfurth measured about 11 feet diameter inside, weighed fifteen tons, and required twenty-eight men to ring it, who, by means of two

wheels and cables, were enabed fairly to *set it*. The bell at York Minster weighed only ten tons,* but thirty-four men had in vain tried to *set it*. At Erfurth, the stock was quite straight on the underside. At York, as in England generally in large bells, the crown of the bell was let into the stock; this might have some influence in causing the difficulty of raising it. At Pisa, a heavy mass of metal was laid on the stock to give momentum when the bell was moved by the direct application of a person working the lever. Considering the centrifugal force in ringing, he should hesitate to trust a large and heavy bell to a single screw, as proposed by Mr. Baker.

Mr. Baker explained, that by letting the crown of the bell into the underside of the stock the centre of gravity was raised, and the oscillations were made quicker to correspond with those of the smaller bells. But Mr. Denison showed from the model that the effect of thus sinking the bell into the stock, not only weakened the stock, but made the clapper *rise false, i. e.*, on the down-side instead of the up-side of the bell, because the axis of the clapper was then no longer below the axis on which the bell was swinging. He had no doubt, with Mr. Taylor, that this was the reason of the impossibility of raising the York bell, and believed that mode of hanging to be wrong; the diminution of the time of oscillation suggested by Mr. Baker, was quite inappreciable, as would be seen by any one conversant with the theory of pendulums.

On the motion of Mr. Donaldson, H.S.F.C., thanks were voted to Mr. Baker for his paper, and to the gentlemen who had favoured the Meeting with further explanation of the subject, and the Members adjourned to the 19th instant.

* Mr. Baker, under date March 17, 1855, forwarded the following communication:—"The great Bell at York is furnished with two wheels, and two ropes to each wheel; it weighs 10 tons 15 cwt., and is considerably the largest bell in this country, being 7 cwt. more than twice the weight of the great bell of St. Paul's in London."

Messrs. Mears of Whitechapel, also wrote that "the great Bell at York Minster was completely raised and fairly rung by *sixteen men* on the 21st of August, 1845. There were four ropes, and four men to each rope.."

ON THE PRINCIPLES TO BE OBSERVED IN DESIGNING MEDIÆVAL DECORATIONS AND ORNAMENTS, WITH REFERENCE TO THE SOURCES OF ORNAMENT OFFERED BY THE NATURAL KINGDOM.

By W. P. Griffith, Fellow.

Being Extracts from the Essay for which the Medal of the Institute was awarded 1855.

Read at the Ordinary General Meeting of the Royal Institute of British Architects, March 19th, 1855.

As in the natural kingdom certain principles are found regulating the most minute growth, and the largest forest tree, so in architecture there are principles common to all its productions. In the mediæval period, for example, those contained in the multiples of the equilateral triangle, the square, the pentagon, and the circle, guided the formation of decorations and ornaments in gold, silver, brass, iron, stone, wood, and even the designs upon encaustic tile pavements, as well as the construction of the cathedral or church itself. This system of regulating form by geometrical figures was carried to a remarkable extent; in the services of the church, the candlestick, the lamp, the lamp-stand, the *corona lucis*, the vessel for incense, the censer, the chalice, the flagon, and even the vestments were designed with the aid of geometry.*

The ornamentation of our earliest sacred edifices was not altogether derived from foreign countries, and what was introduced received certain modifications. Through the diligence of antiquaries, a collection of Roman, Saxon, and Norman remains has been of late years amassed, from an examination of which, a system of decoration, floral and otherwise, can be traced, which may have exercised its influence on mediæval architecture; and it is admitted by all who have devoted their attention to the details of that architecture in this country, that they are less Italianised than those on the continent, and that they possess an indigenous character.

So extensive is the range of art decoration in every civilised country, each of which possesses its own characteristic development, that it would occupy a lifetime to collect, analyze, and study comprehensively, the resources of so widely cultivated a field. It has often been urged that we must look to nature as a source for ornamentation, but when she has been sought, the student has not known what course to follow, nor how to proceed in a natural conventional manner. The difficulties which encompass attempts to design modern ornaments are often referred to; one writer says, "As a general rule, the less closely the artist attempts to embody nature, the more safe he will be," and another writer observes that "it is extremely difficult to lay down any rule to say how far nature should be followed, or how far she should not." The difficulties, however, are not so great as they are supposed to be, when a little trouble is taken to comprehend the rules for embodying nature in decorations and ornaments. So many unmeaning designs having been thrust upon the public by those who have not entered deeply into the subject, have created a prejudice against modern performances; and it has therefore been considered "safer" to copy from those sanctioned by antiquity, than to produce new ones. Although it is true that modern designs have to be judged by posterity, to be worthy of lasting approbation; yet, unless efforts are made to create new ornaments no progress can be anticipated.

One of the objects of this essay is to point out the best way of obtaining plants and rendering them available for the purposes of design; and another is to guide the student in his attempts to produce ornaments in relief, more or less detached, and ornamental surfaces. Though

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* See A. W. Pugin's Glossary of Ecclesiastical Ornament.

he need not seek to equal Lindley, Hooker, or Balfour, he should know enough of botany to be acquainted with the plants and foliage he selects for adaptation. "The scientific botanist recommends his pupil to provide himself with a pocket lens of about half an inch focus, and a few quires of paper; the former to assist him in examining, and the latter in drying the fresh specimens he may collect." The architect, however, requires a greater knowledge of *living* plants than of *dead* ones; leaves and flowers, after they have been flattened, are of little use, as the undulations and the beauty of the forms are lost. Lindley says, "the apparently flat surfaces of leaves and petals are only segments of large circles. This is a necessary consequence of the primitive spheroidal form of vegetable tissue, which, in whatever way it may develop itself, must always be bounded externally by the curved sides of the parenchyma." The form of the leaf, the disposition and projection of the veins, the position of the leaves upon the stem, the form and character of the stem, the flowers, and the fruit, are all of moment, and require to be carefully studied. It is also important that the name of each plant selected, for a capital for instance, should be given; that of the order will not suffice, because the leaves vary in form; and although the leaves of one plant may be well adapted, those of another belonging to the same order may be entirely unsuited to the purpose.

The plants collected should be kept in a tin case until they have been accurately copied whilst they are fresh, as the forms of their several parts disappear when they are dried. The principles to be followed in imitating nature are those which she herself adopts in the organization or arrangement of her works; no abortions, imperfections, or peculiarities ought to be copied, but the architect's object should be "to make things not as nature makes them, but as she would make them." Perfect foliage, flowers, and vegetable forms copied in decoration, must be distributed and applied in strict accordance with Nature's rules. For example, if we have a square panel or space, and desire to decorate it with the leaves and fruit of the oak,—to take a branch from the tree and lay it upon the panel, would produce an exact imitation of nature, but would show no design, nor geometrical distribution; if, however, the branch be geometrically disposed, *i. e.* the leaves placed upon the diagonal, and the fruit upon the diametric lines,—the leaves and fruit would be *per se* exact imitations, as they sometimes should be, although the design or arrangement of them in the panel would be conventional.

In Grecian and Roman decorations, the foliage, fruit and flowers were varied according to their use and position in the buildings. The panels at the side of the entrance in the exterior of the Pantheon at Rome; the frieze round the exterior of the Temple of Vesta at Tivoli; St. Paul's Cathedral, and the upper entablature of the Banquetting House at Whitehall, offer examples of excellent imitations of foliage, fruit and flowers, arranged in festoons or garlands, with ribands round their stems and stalks. This classic system differs considerably from the mediæval one; in the former, the festoons or garlands are heterogeneously mixed and stuck on the buildings or sculptured purposely to appear so; and sometimes the ribands are suspended from nails; but in the latter, the foliage and fruit grow out of the stonework with all the regularity of nature, whom the architects endeavoured to imitate truthfully,—the leaves and fruit of the maple, ivy, vine, oak, strawberry, and many others, being exactly copied, and arranged upon natural or geometrical principles.

In the best periods of architecture, design or mental arrangement upon natural principles was universal, but in modern times it is mostly dictated by caprice, fancy, and chance, except in those instances in which the decorations have been copied from the antique; the best examples of which will always be esteemed, because their forms have been derived from nature.

In mediæval ecclesiastical architecture, the treatment of ornaments remote from the eye, and not easily inspected, varied from that laid down by Sir William Chambers for Roman ornaments seen at a distance, inasmuch as the former were generally finished with the utmost elegance and minuteness, even in the portions concealed from view; this perfection has been supposed to have arisen from the

impression that the whole carving and execution were an act of adoration, in which the artist offered up his best faculties to the praise of the Creator. Such decorations are more beautiful than the garlands, festoons, and similar ornamentations of Roman architecture, inasmuch as they are not merely taken from nature, but are disposed in conformity with the laws of vegetation. The petrified vegetation in the choicest examples of our ancient Gothic churches appears to grow out of the buildings, and not to be plucked from the garden or hedge, and stuck on, as in some English and in many foreign instances. The stem either flows out of the cornices, capitals, and traceries, or is hidden by foliage; the end of the stem broken off from the tree or plant is not visible. Crockets have a better effect when they are connected by and are set upon a continuous stem, as in the lower part of the pediment of the great west door of York cathedral, and not as on the south transept of Beauvais Cathedral, where they do not appear to grow out of the stone.

"The ornamentist," says Mr. Dyce, "is an imitator of nature in a sense very analogous to that in which the man of science may be termed so, who applies her operating and governing laws and the means and hints furnished by her to the accomplishment of new ends of convenience and utility; and the real position, accordingly, of ornamental design is side by side with practical science: its real use being to hide, by a coating of beauty, the skeleton-like contrivances of the latter, and thus to bring them into the condition of the works of nature, in which beauty and utility are always concomitant."

In the ornamentation of sacred edifices, it would be well to consider the system which prevailed in the decorations of the first churches which the Christians were allowed to build above ground. St. Jerome tells us that the priest Nepotian decorated the interior of his churches with flowers, foliage, lilies, and the gay branches of the vine. When pictures were attempted upon the walls or cupolas, the subjects were taken from holy writ, and the painters had the same source of inspiration as the artists who decorated the catacombs of Rome; and that source was the Bible. We are told that these catacombs, destined to the sepulture of the first Christians, and decorated during the persecutions of the Church under the immediate dominion of sad thoughts and agonizing duties, offer representations of heroism in the historical pictures, and graceful and cheering subjects in the purely ornamental parts, as the vintage, pastoral scenes, agapes or love feasts, fruits, flowers, palm-branches, laurel crowns, lambs, and doves; in a word, nothing but what suggests a feeling of joyous innocence.

In the Middle Ages, the monks rendered their abbey gardens attractive by flowers; they reared an appropriate one for each holy day; flowers thus became subservient to sacred uses, and useful in imparting instructive and pious lessons to the young. The study of ecclesiastical botany was revived and considerably advanced; herbs and flowers received a special nomenclature; medical botany was also much improved, and the plants named by the classic authors were consulted and compared with native specimens. Flowers were also dedicated to saints, and in honour of the Virgin Mary. In early times, each day had its flower of a particular colour, and the common events of life were marked by floral decorations; the funeral had its cypress and rosemary, and graves, crosses, and tombs were decked with suitable trees and flowers. Altars also at certain times were set out with floral symbols. The idea of perpetuating in stone the beauties of the vegetable kingdom, emblematically expressed, was a happy one of the greatest antiquity, and there is no style of architecture without its flora, more or less conventionalised.

In ecclesiastical decorations only such trees, plants, foliage, flowers and fruit are to be selected as symbolize Holy Writ. The Holy Eucharist, the Holy Trinity, the Crucifixion, may be symbolically expressed by vegetable products, either naturally, or by a geometrical arrangement, termed by some writers conventional. Those which do not naturally express by their form symbols, are to be when selected so arranged upon geometrical figures, as to form religious emblems. A

church ought to be decorated with the greatest care and skill, to present a wonder-work of art, and from the natural and artistic beauty of its decorations vie with nature herself; with Pliny, we ought to be able to exclaim "Hic in unum coacta rerum naturæ majestas;" here we see Nature in all her majesty developed within a narrow compass.

The ornaments for the several parts, the tower, the nave and ailes, the transepts, the choir, the chancel and its ailes, should be different both in degree and style. Of flowers, possessing a sacred symbolism, the Ecclesiological Society mention—the lily, the rose, and the marygold, (all symbols of our Lady); the herb Benet, (symbol of St. Benedict); the ivy, (of immortality); grapes and wheat-ears, (of the Holy Eucharist); the oak, (of virtue and majesty). The Holy Trinity is symbolised by trefoils, and ternate, bi-ternate, and tri-ternate leaves. The natural symbols of the Crucifixion, are the passion-flower (passiflora), and flowers of the cruciferæ order, with sepals 4 cruciate, petals 4 cruciate, alternate with the sepals.

Schlegel has observed in an essay on Gothic Architecture (translated by Millington), that in the "second-floriated Gothic style (decorated), the same figures of the triangle and the square, the circle and the quatrefoil, form the groundwork of all those (floral) decorations, which, as in the early Christian, are introduced with a more profound attention to the scientific structure of the building. But these no longer appear in naked simplicity and geometrical exactness; they are all veiled with clustering foliage and the luxuriance of vegetable life: as in the enamelled carpet of spring, we cannot, amid its verdant productions, clearly discern the precise geometrical symmetry of each isolated form, but see all bloom and unfold their beauty together, in one general glow of life and immortality! The very existence of Gothic architecture seems bound up with the luxuriance of its forms and floriation. Hence the unvaried repetition of the same decorations, their plant-like similarity, and the deeply expressive yet tranquil mystery, the joyous loveliness and animation, which fill every beholder with reverence and admiration. The symbolism of Gothic architecture is, indeed, of the highest order; that of painting appears feeble in comparison with it, and its allusions to divinity embarrassed and uncertain. Architecture, on the contrary, by its imitation of the beauties of nature, brings the idea of the Divinity palpably before our minds, even without any direct allusion to the mysteries of Christianity. Christian faith and hope had, however, no trifling influence on the development of ecclesiastical architecture." Coleridge says that a Gothic church "is the petrifaction of our religion." The rose and trefoil, in various combinations, may be recognised as the basis of all the highly artistic foliation with which the cathedral at Cologne is adorned. In foliated forms, the cross is made strikingly manifest, by selecting cruciferous plants, or by arranging leaves in the form of a cross.

It is believed by all who have given attention to the subject of natural ornamentation, that leaves, flowers, and fruit, when selected for decorations, are conventionalised; and it is quite true, that the early architects, when they sought nature for ornament, did dispose them in a geometrical manner; they did not place vegetable products upon walls, columns, bosses, &c. in an undesigned way, but they had a system upon which their proceedings were grounded. It would be futile to endeavour to secure greater beauty and precision in decoration, without inquiring into those laws which directed the formation of those interesting and often beautiful natural designs of the early architects; and the nature and extent of conventionalism should be carefully analyzed, and separated from the mis-shapen aboriginal examples, in which the early sculptor endeavoured to imitate nature clumsily and imperfectly, but did arrange vegetable products conventionally. The ignorant imitation of nature must not be confounded with the conventional or geometrical disposition: on comparing Anglo-Roman, Danish, Saxon, Norman, Early English, Decorated, and Perpendicular, sculptured or carved foliage, flowers, and fruit, we shall find that all are more or less conventionalised; but nature in the earlier periods is hardly known as such, through the sculptor's want of imitative skill. When

foliage, flowers, or fruit, are selected for decorative purposes, they should not be portraits of any single specimen taken from a garden or hedge, but they should be ideal; in fact, more perfect than nature forms any one leaf or flower, so as to realise the remark, "art is nature, better understood."

Mediæval Decorations and Ornaments may be considered under two classes:—1. Ornaments in bold relief, more or less detached,—these include capitals, corbels, bosses, crockets, finials, pateræ, dog-tooth, ball-flower, nutmeg ornament, Tudor-flower, roses, poppy-heads, fleur-de-lys, &c.;—and 2. Mural or Surface Ornaments;—these comprise panels, spandrils, diapers, encaustic tiles, &c. The following extracts relate to the designing some of the ornaments, but the Essay itself, in which each is historically described and analytically treated, must be consulted for many of them, which are illustrated by numerous diagrams.

The capitals of columns generally give a clew to the date of a building. They vary in size, form and decoration, and are either moulded or foliated. The bell should be carefully proportioned and curved; otherwise, though ever so well decorated, it will be a deformity. Norman capitals are often degenerated imitations of Roman work. Early English capitals and ornaments have sometimes trefoil leaves introduced, variously combined, and are boldly executed and enriched in an elaborate and elegant manner. Good examples are seen in Salisbury and Wells Cathedrals. "The origin of foliage" says Paley, "on capitals, whence it was transferred to bosses, corbels, window and doorway-arches and jambs, and other positions, may be distinctly traced through the Romanesque to the Classic, and especially the Corinthian style," and the idea of the latter was borrowed from the Egyptians. The foliage upon the capital of a mediæval column judiciously rises above the neck-moulding, so that the latter does not prevent its being seen. When the foliage rises from or is in contact with the neck moulding, the projection of the latter foreshortens the capital, and gives it an inelegant appearance. Some Mediæval capitals have heads and figures sculptured upon them, but they should not be imitated.

For the dates of buildings, Mr. Repton * relies more upon the ornaments and details, than the form of the arches only, but if, as he states, many capitals in different buildings are old ones *recarved* and made to correspond in some degree with new parts or additions, great attention and care should be given in examining architectural details before an opinion is pronounced. In Bingham Priory, Norfolk, erected in the reign of Henry I. a building was added at the west end in the time of John or Henry III. in a different style of architecture, and with round capitals, but, to blend the old massive part of the priory with the new building, some of the old square capitals were recarved, and the abacus rounded off.

Norman and Lombardic capitals are variously ornamented, and exhibit a great variety of designs, which owe their origin primarily to degenerate imitations of the Tuscan, Doric, Ionic, Corinthian and Composite capitals of the Roman orders; the results of these attempts have produced numerous very curious decorations, but of no architectural value or importance. The crypt of Rochester Cathedral contains Norman capitals; each has a square abacus, 2 feet square, and $4\frac{1}{2}$ inches in depth, and beneath it an ovolo and an astragal or bead, — it resembles the capital of the Tuscan order. The piers opposite to these columns have each a similar abacus, with a channel beneath it $\frac{5}{8}$ths of an inch deep and then a cavetto 2 inches deep. This is often used as a string course. The next kind of capital, which is common, is a modification of the Doric. It has a chamfered fillet on the top, and the original broad flat abacus and ovolo are united, the angles being rounded off form an escalop edge, and under the whole is a bead. Some writers describe the form of this capital as an inverted cone, cut to present four flat sides, or faces. By channeling the conical mass, a series of escalops are formed, and the spaces below them are

* Archæologia, vol. xxxiii. page 140.

sculptured to resemble inverted and truncated semicones. Some of the pier-caps in St. Bartholemew's the Great, London, have six semicones.

Of the Norman voluted capitals (after the Ionic) there are many kinds, varying from extreme simplicity, as seen in examples in Canterbury Cathedral, and in the crypt of Lastingham Church, Yorkshire, to elaborate enrichment, as in St. Peter's Church, Northampton. Adaptations to a certain extent of the Corinthian capital are seen in several of our cathedrals and churches, as well as in those on the continent. There are other examples of capitals charged with sculptured representations of human figures, animals, foliage, &c.; which thus resemble many capitals in the old churches of Normandy. In late Norman and in early English capitals, the foliage is arranged vertically round the bell. In decorated capitals the foliage flows horizontally. Perpendicular foliated capitals are not common; small leaves, or pateræ, are more frequently set at intervals round the shaft above the neck. But the vine and the strawberry leaf are sometimes found; though very differently worked from the deep overhanging foliage of the earlier styles, and forming only a shallow surface ornament. The dog-tooth, the nail-head, the ball-flower, and other ornamental mouldings, sometimes occur in capitals, as well as crests of the Tudor flower, or of minute battlements, in the later buildings. Even angels' heads with spread wings are found, as in the belfry-arch of Great Shelford, near Cambridge, and in the choir of Wingfield Church, Suffolk. Occasionally (in Norman work commonly) some subject is grotesquely sculptured below the abacus; of this there is a very curious example at West Keal, Lincolnshire; or a subject is intermixed with the foliage, as in some early English capitals in the south transept and the north porch of Wells Cathedral. Although there are many beauties in Mediæval architecture, there are also faults. In Pugin's Gothic Ornaments, plate 86, shows some stone capitals in the entrance to the great hall, Kenilworth Castle; the central one is decorated with the foliage and fruit of the oak; the end of the stem ought to have been hidden, but it is a conspicuous object in the upper part of the capital, and the foliage is growing downwards.

Stone pateræ upon fonts, panels, &c. are often composed of four leaves, or cruciferous flowers, forming diamond-shaped or square leafy ornaments; and string-courses and cornices are often studded with these at intervals of one square apart, as in the roof of Crosby Hall. In this instance the ornaments are disposed in squares, with one plain square space between each. In Pugin's Specimens, Vol. I, plate 48, the square ornaments (or ornaments arranged by squares) are placed two squares apart; and in Vol. II, plate 52, fig. 3, they are two squares and a half distant; so that it depends upon the extent of decoration or limitation of outlay, whether the distance apart be one square, one square and a half, two squares, two squares and a half, &c. Sometimes these square ornaments or pateræ contain only one leaf, set one square apart and connected by a stem or branch, which is so introduced in a cavetto as to form a cornice. The stem passes through the foliated squares and spaces in a wavy manner with a fir-knob or two upon the stem between the foliated squares, so as to relieve the otherwise empty spaces, as in the cornice of the canopy of Lady St. John's Monument in Westminster Abbey.

When plants are represented in cornices, the stem is usually bent to form a flowing line, and although more or less hidden by the foliage it is still occasionally visible, and sometimes it is a prominent feature. The form should therefore be particularly observed; it is not always cylindrical, but it is often as it were formed of fibrous bundles, having a fluted appearance; in these instances it may be made an ornamental feature, as the undulations produce a variety of light and shade, not to be obtained in a simple cylinder. The stems of some plants are triangular, and wedge-shaped with curvilinear sides, and sometimes they are square. Graceful flowing stems and foliage often decorated the pyx (containing the Eucharist) formed of silver, ivory,

or "de opere Lemovitico." The foliage was of a pale green, and the general groundwork or field was of a cobalt blue. New College, Oxford, possesses a Pax, of silver parcel-gilt, which has an ornamental border with foliage, roses, &c. In sculpturing leaves, great care should be taken to make the veins on the underside in relief, when that part is presented to the eye; leaves clasping spherical ornaments should have their backs next the eye, and their upper surfaces on the sphere. In many instances, the back of the leaf being laid on the sphere has an unnatural and constrained appearance. It must be recollected that a leaf contains ribs and veins, which branch in different ways, and care should be taken to put those proper to the peculiar kind of leaf. We have already observed, that it is not necessary to represent in detail each stamen in a flower, but roughly to represent the pistil and stamens *en masse;* so also with the leaves, if the margins be toothed, and the toothings be sharp and small, the latter need not be expressed. Sometimes each serrature of a leaf is itself serrated; this second serrature is not to be indicated. The general character and form of the leaves should always be maintained. When all these points have been attended to, a leaf assumes a conventional form.

Among the ornaments prevailing in the later period of the Perpendicular style, are the Tudor flower, and rose. The Tudor flower is a foliated crest set at intervals upon the cornices of screens, or upon tie-beams, transoms, capitals, corbels, &c.; it is said to resemble a strawberry leaf. A small and simple trefoil is frequently placed in the spaces between the leaves. A corbel in Magdalen College, Oxford, is enriched with this flower, which is rarely found in work of the fourteenth century. When used as a crest it is variously formed, but always upon a regular system. Sometimes a row of attached squares (placed lozenge-wise), their bases connected by inverted semicircles, forms the groundwork of the design. A leaf, or a conventionalised form of leaf, is arranged in each square, and often three buds, berries, or other fruit are set up in a pyramidal form in the spaces between the leaves. The squares are sometimes not attached, but arranged at certain distances apart.

There are several kinds of architectural roses; the simple five-petaled rose, a conventional form of the dog-rose;* the double five-petaled rose, the triple five-petaled rose; roses with six single petals, and double and triple six petals. The single rose was used in the reign of Henry VI, and the double rose surrounded by rays is said to be the cognizance of Henry VI. and Edward IV. It occurs on pulpits in Worcester Cathedral, and Magdalen College, Oxford. The double rose ornaments a pedestal in a niche of Henry VIIth's Chapel, Westminster. It is often used alternating with fleur-de-lys, and it is sometimes enriched by a floral wreath.† The triple rose is beautifully sculptured upon the south porch of King's College Chapel, Cambridge; it occurs with the portcullis.‡

Spandrils, particularly during the Perpendicular period, gave the Mediæval architect another field for the exercise of his skill in designing floral decorations. In the early periods they were mostly plain. On the tomb of Archbishop Theobald, in Canterbury Cathedral, the space between the arches has simply a trefoil on an upright stem. In the chapter-house of that cathedral, the spandrils have sunk panels filled with diaper-work. In the spandrils of the arches in the triforium and in those of the lower arches in Westminster Abbey, there is diapering. Each spandril of a Perpendicular doorway is mostly composed of a quatre-foiled circle, having a shield, rose, or foliage in its centre, and the remainder filled with foiled panels. The spandrils of the porch of King's College Chapel, Cambridge, exhibit the Royal Arms of England in elaborately foiled circles, and in the panels the Tudor rose.

During the same period the spandrils of the nave arches were often highly ornamented as in the Church of St. Mary the Greater, Cambridge.

In designing ornaments in spandrils, especially of the Perpendicular period, the usual course was

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* This flower is very common in Yorkshire, and has the repute of being the white rose of the Yorkists.

† This is the Tudor rose.

‡ The rose and portcullis are badges of Henry VII.

to insert in the triangular space either vertical foiled panels, a circle quatrefoiled, or a square modified for a shield or a portcullis. It was an easy and save-trouble system to fill up a spandril with a foiled circle, and then to foil and foliate the spaces remaining; but to group foliage, flowers, and fruit, was neither an easy nor an economical process. When plants were selected, the geometrical rule for arranging them was the same, although the result was different. The stem, if its root was not hidden by the leaves, germinated from one of the angles, and was coiled in a circular form, sending out shoots to the intermediate angle, and to fill vacant spaces, and it then assumed a flowing line to the extreme acute angle. The end of a stem, as if broken off, should not be introduced. The Mediæval architects did sometimes represent foliage with such stems in crockets as well as in spandrils, but these examples should be avoided, as it is much better for the branch to grow out of the building than to appear to be stuck on. Foliage flowing from the mouths of animals, or from an unnatural extension of the tail, should not be imitated. Sometimes the latter assumes beautiful curved forms and foliage; it would, however, be as ornamental and less absurd if the animal was omitted.

In Pugin's Gothic Ornaments, plate 37, shows two spandrils from Winchester Cathedral; in one example the stem grows out of the lower angle; and in the other (which consists of oak-leaves and acorns), the end of the stem is hidden beneath one of the leaves. Although the stems are correct, an unnatural growth is given to one oak-leaf, which is distorted in length to fill the space.

The sculptured representation of flowers, applied to relieve the plain surfaces of walls, is termed diapering. In selecting flowers for this purpose, care must be taken to choose only those forms which are suited to the geometrical spaces allotted to them. For example, a flower with petals rounded at the apex is not well adapted for a figure with acute angles; the more obtuse the angle the better will a flower with rounded petals fill the space, and *vice versâ*. Upon a monument in the choir of Canterbury Cathedral there is a diaper, the design of which consists of a flower with six petals, slightly raised in relief within a hexagonal compartment; the flower has petals well suited to the angles of the figure. For square forms cruciferous flowers are chosen, as in the nave and choir, and on the tomb of Aylmer de Valence, in Westminster Abbey. If the spaces be triangular, or hexagonal, flowers having a ternary division of parts are the best. For octagonal compartments, those having a cruciferous division should be chosen; and for filling pentagons and decagons, those with a quinary division of parts. In this work, the leaves and fruit of the oak are met with; as on the choir screen of Lincoln Cathedral, and the cornice of the Queen's Cross, Northampton.

Diapers were more frequently produced by colour than by sculpture in relief; in the absence of historical paintings upon walls, the large surfaces were generally diapered. They were of several kinds; that commonly met with extends as a running pattern, often executed in a deeper shade of the ground colour. There is a variety of this which may be termed, with more propriety, arabesque; it is seen in the groined canopy over the tomb of Aveline, Countess of Lancaster;* and consists of an entwining pattern of vine leaves and fruit, the fruit and stems red, the leaves green; the ground straw colour, perhaps originally gilded. A second form, perhaps better understood by the term powdering, has a profusion of small sprigs or flowers, generally black or gold, scattered over the ground. The diaper of a wall sometimes consists of nothing more than the founder's initials, the monogram I. H. S. and like devices, in red, geometrically arranged upon an uncoloured ground, that is a ground which has no other colour than the prevailing tint of the building. The use of diaper is to supply the place of middle tints, the introduction of which destroys the brilliancy, and interferes with the keeping of polychromatic painting; a mass of colour of whatever weight or

* In Westminster Abbey.

prominence may be enriched, and at the same time toned, to almost any limit, by a judicious use of diaper.

The sides of the font in Swaton Church, Lincolnshire, are diapered, the flowers are cruciferous, and the form of the petals accords with the square outline of each diaper. The date of the font is *circa* 1340. The sides of the font in Ewerby Church, Lincolnshire, are also diapered.

Great care and judgment are required in selecting vegetable productions for ecclesiastical decorations and ornaments; many plants are available for this purpose, and very many are not. Something more is required than a simple trefoil, quatrefoil, cinquefoil, &c.; it is absolutely necessary that each leaf selected be suited to the space allotted to it; to twist or distort a leaf in an unnatural manner is not required. An error of this kind occurs in Bloxam's Gothic Architecture, in a modification of the dog-tooth ornament (from Adderbury church, Oxfordshire), converted into a knot of four ivy leaves; it will be observed, that in each leaf the side ribs branch from a midrib, instead of which the ribs ought to radiate from the stem, palm-like, as in the ivy leaf. Nature must not be misrepresented.

Among other plants adapted for art-purposes, we may suggest the following:—Trifolium fragiferum; trifolium subterraneum; medicago polymorpha; fragaria sterilis; rubus; limonia trifoliata; iatropha gossypifolia; panax aculeatum; solanum fuscatum; cynanclum extensum; geranium robertianum; citrullus or auguria; chelidonium majus; adoxa moschatellina; alchemilla; gronovia scandens; atriplex; sorbus torminalis; sorbus sativa; amygdalus; cataputia minor, and lathyris; androsæmum; berberis oxyacantha; viola canina; tragopogon porrifolius; and many others. All these may be seen in Curtis' Flora Londinensis.

In addition to the diagrams accompanying the Essay, there are forty-two drawings arranged in four divisions. In the first division, twenty-four illustrations exhibit an analysis of mediæval ornamentation and prove that, however diversified in appearance Gothic ornaments may be on the buildings, they are quite as capable of being classified and reduced to system as the ornaments common to any other style of architecture. It will be observed that ornaments are not required to be always symmetrical; their parts must, however, be properly balanced; the quantity of sculptured ornament in each half should be equal. The conclusions to be drawn from an examination of these twenty-four illustrations are—

That mediæval ornaments are designed in conformity with geometrical figures, and are capable and worthy of analysis.—That the great variety of forms does not militate against an analysis being attempted.—That the decorative portions need not be limited to the foliage and flowers selected by our ancestors, but that any others adapted to the geometrical spaces, and properly conventionalised, can be employed.—That geometry is the basis of all true ornament.

In the second division, six designs for double pateræ in decorated cornices are submitted. The foliage is directed by the diagonals of two attached squares, and has been chosen from the vine, wheat, the oak, the Guelder rose, the ivy, the maple, and the lily of the valley. These double pateræ are designed upon the same principles as the ancient mediæval ones; they are set at certain distances apart, as the single pateræ.

When a child is first instructed in writing, diagonal lines are ruled by the tutor to guide his hand, but after a time when the eye and hand have received the proper amount of practice, the lines are no longer required. With the sculptor or artist it is the same; his eye guides his hand in properly proportioning the several parts of each ornament; the course of the stems, leaves, flowers, &c., whether they be curved in a horizontal, perpendicular, or a diagonal direction, are all freely executed by his practised hand, although in the first instance all the geometrical rules had to be demonstrated for his initiation.

In the next series of designs for mediæval ornaments, the following vegetable products have been used, viz.—the water buttercup (for the panel of a font); the ivy-geranium; the plane tree; the rose; the myrtle; the crowfoot; the wood anemone; and the liverwort. A new feature is exhibited by working bosses out of the regular bodies. If we select the dodecahedron, the first process will be to produce a pendant hemi-sphere, and then to mark the angles or points for the six equal pentagonal faces (as only half of the regular figures is presented to view); each rose is then wrought out of the space thus allotted; the surface should not be *flat*, but in *spherical relief*, or convex. The central space contains a rose with two rings of petals, and the other flowers are single petaled. The half-faces of the pentagons adjacent to the ribs of the groining are to be filled with two or three rose leaves. The roses are conventionalised; the stamens not individualised, but roughed out *en masse*. Another boss is generated by the icosahedron. Bosses executed in this manner form "knots of reposing flowers."

The fourth series of designs shows enriched cornices; the plants selected are the dog-rose, the white bryony, and the large white bindweed. The stems of these plants are bent to form flowing or wavy lines, which can be produced by uniting a continued series of alternating semi-circles. When the eye has been educated for, and the hand accustomed to, this kind of ornamental work, the design can be marked without mechanical means, which are only required in tuition. The pistils and stamens of the flowers are not to be separately sculptured or individualised, but they are to be roughly worked *en masse*.

In conclusion, it will be found that there are principles conveyed to us through the natural kingdom, which man has endeavoured to apply to all he undertakes, and certain it is that in architecture and its concomitant arts, he has followed the working of nature to a great extent;

"That Art
Which you say adds to Nature, is an Art
That Nature makes."

WINTER'S TALE.

The architect is indebted to nature for geometry, which is the true test and foundation of all pure ornament; without the aid of that science art-combinations would cease to be graceful, and their symmetrical distribution of parts would no longer exist. So long as ornamentation is disposed as designed upon natural laws, so long will it be beautiful and endurable, for

"A thing of beauty is a joy for ever."

But if, on the contrary, unnatural outlines and fantastic shapes be fostered, the "growth of the spreading boughs and the budding of the clustering foliage will be arrested, and an unhealthy formality mistaken for beauty."

Mr. ASHPITEL, Fellow, said that there was generally much confusion on the subject of geometrical lines in decoration. Almost every line that was elegant to the eye might at the same time be mathematical and geometrical; and many lines which appeared fantastic had nevertheless been produced by the compasses. The ordinates and co-ordinates of the most difficult curves could be easily found by the profound mathematician. Cellini stated in his autobiography that he had obtained great praise in his carving and chasing, by breaking through the rules which fettered other artists. The commonest herbs and vegetables, the laurel, the fennel, and the parsley, afforded the most exquisite suggestions for architectural decoration, but whilst this was felt by every one, it was impossible to lay down rules upon the subject, or to apply the square and compass to objects of such a kind. The attempt to subject to rules the finer feelings of the mind could only end in failure,—as

much in architecture as it had in music and in poetry. The greater part of what were conventionally called geometrical forms were in fact perfectly ungeometrical; and, if the leaf of a plant were examined, it would be impossible to find in it anything approaching either to a circle or a straight line.

Mr. I'Anson, Fellow, regretted that there had not been time for reading Mr. Griffiths's essay at greater length, inasmuch as, however interesting and valuable in itself, the portion which had been read had merely suggested some points which were not carried out in detail; especially the view of tracing the age of every building by the decoration of its capitals. It would further be most desirable to trace the original types of some familiar ornaments, such as the Greek honeysuckle (which was in fact as little like a honeysuckle as possible), and a peculiar flowing Byzantine ornament, the true type of which was entirely unknown. Mr. Griffith had adverted to the trefoil, as used in the early English period, but not to the twisted celery of the same era, nor to the peculiar knob or swelling lump (as he might term it) which was constantly represented in the decorative foliage of the 13th and 14th centuries. It was not necessary that architectural ornament should involve a perfect knowledge of botany or botanical forms; but the vegetable form represented should at all events give an idea *of life*, or of an endeavour to break out into life. This effect was admirably realised in the Renaissance style, where the rushing of the sap might be almost seen through the fibres of every ornament. The respective forms suitable for execution in wood and in stone might also have been referred to with advantage, and indeed the subject generally was by no means exhausted.

Mr. Twining, Contributing Visitor, observed that there was scarcely any limit to the vegetation which might be introduced in panels, friezes, &c.; but it would be desirable to distinguish between those forms which were appropriate for *decoration* merely, and those which could be properly applied to *structural* features, such as capitals and other essential members of a building.

Mr. Papworth, Fellow, reminded the meeting that the paper, as read, was but a small portion of Mr. Griffiths' essay, and he proceeded to explain the theory of that gentleman as to the steps by which the irregularity of vegetable types had been reduced to a legitimate and artistic regularity by the mediæval architects. This point Mr. Papworth illustrated by a sketch of the five-petaled Tudor rose, given as conventionalised in Mr. Griffiths' paper, by inscribing a pentagon within a circle, and repeating the operation with smaller circles and pentagons alternately.

Mr. W. Burgess, Visitor, said that, so far as his observation went (especially in France), there appeared to be an utter absence of geometry in mediæval decoration, excepting in the somewhat regular recurrence of leaves and bosses. In cornices, however, the foliage was always as conventional as possible. The ornamentation at Beauvais was *almost* natural, the stalk of the plant being shown; but at the same time it was partially covered with leaves, and to a certain extent concealed, in accordance with the feeling of the age. So in the frieze of the portal at Noyon, the stems were knarled, and not geometrical in form, and in the Sainte Chapelle, the horned caps were formed of bunches of stems put together. As a rule, he believed that the less geometry in the application of foliage to decoration the better the effect. Generally speaking, he considered that the designers of mediæval decoration had drawn with a free hand.

Mr. Pocock, Fellow, said that the distinction between natural and geometrical forms was clear and obvious. The most important question to them, as architects, was how far they ought to conventionalise nature. Poetry had been defined as "idealising the real and realising the ideal," and he considered that ornamentation should do something of the same kind. An individual plant might be too ideal, and it was then necessary to recur to the true type after which nature herself had formed it, and from that original to realise the object appropriately in the particular material employed.

Mr. Ashpitel cautioned the meeting with reference to "conventionalism" in art, and referred especially to painting; to the "thunder and lightning" school, in which the colours were mixed and applied as if with a broom; to the "suggestive style" in which a shadow from outside the picture, or a portion of a figure, was intended to convey a great intensity of meaning; and lastly to the "Pre-Raphælite school," in which high art was supposed to be reached, if the flowers in a lady's hand were wonderfully clever, although the painting of the figure might be abominably bad. Certain terms were used again and again till they became accepted, and did considerable mischief; and of all others the term "conventionalism" required interpretation.

The Chairman (Mr. T. H. Wyatt, V.P.) congratulated the meeting on the remarks which the careful labour and research of Mr. Griffiths had elicited, and a vote of thanks having been passed to that gentleman for forwarding the extract from his Essay, prepared for reading, the meeting adjourned.

ON THE ARCHITECTURE OF THE PRE-GOTHIC AGE IN GERMANY, OR THE ROMANESQUE DEVELOPMENT OF THE RHINE AND CENTRAL EUROPE.

By C. F. Hayward, Esq.

Being Extracts from the Essay for which the Medal of Merit was awarded in 1854.

Read at the Ordinary General Meeting of the Royal Institute of British Architects, April 30*th*, 1855.

The position which the architecture of the tenth, eleventh, twelfth, and thirteenth centuries—generally known by the comprehensive term Romanesque—holds midway between the classic severity of earlier ages and the aspiring freedom of Gothic construction, gives it the peculiar interest of being a link of the great chain which connects the old with the new civilization of Europe—the close of Roman splendour with the early dawn of Mediæval art. From the Romanesque buildings of the twelfth and preceding centuries, we learn how the great transition took place from the classic characteristics of breadth, horizontality and repose, to the airiness and upward tendency exhibited in the early Gothic structures: a change which, from first to last, occupied the space of nearly a thousand years in its accomplishment. Though extensively practised in these islands by our Norman conquerors, the Romanesque style received such an impress from their hands, and was so deeply imbued with their spirit, that it has retained their name among us as a distinctive appellation. It is to the Continent, therefore, that we must rather look for the purest characteristics of the Romanesque, and especially to Germany, which, though borrowing its original ideas from its subjected Italian estates, was amongst the first to carry them out with individual design, and the last to forsake the cherished forms, and yield up its sturdy "Rundbogen" for the novel and more graceful "Spitzbogen," or pointed arch.

Along that great highway, the Rhine, many a flourishing city was planted by the enterprising sons of the mistress of the world. And now on its banks stand clustered those venerable creations of Christian art, which far excel the few traces remaining of Pagan work and classic decline. Not only, however, on this spot, but throughout Central Europe, are to be seen traces of this once popular style, modified in accordance with local circumstances and individual feeling.* Distinct from, though closely allied to the Lombard edifices of the same date, and the examples of Byzantine influence exhibited at Venice and Ravenna, these Romanesque buildings claim equal kindred with the rival forms adopted in the buildings of the early Christian Church, the flat-roofed Basilica, and the domed temple of Byzantium. And it need excite no astonishment to find such clear traces of the chief features of each, when we remember that both were founded at the same time—for the same object—on the ruins of the same development of Art.

Greece perfected the trabeated system of support. It was adopted at Rome, with the addition of a new, and, apparently, antagonistic principle—arcuation. Timidly at first, though boldly afterwards, the two were blended till confusion became the result. Order succeeded under the artistic hands of the Lombards; and the style, further improved and developed by their German conquerors, became the great and noble Romanesque, which, extending its influence from central Germany towards the

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* See Puttrich's Work on the Architecture of Upper Saxony, from the 10th to the 15th century. See also the Works of Moller and Boisserée for illustrations of the buildings described in this paper.

north and the west, in after ages returned to invigorate the productions of its original country, the south. But, independently of their prominent position in the pre-Gothic age, and of their connection with Rome and Byzantium itself, constructively, artistically, and historically, these Romanesque edifices have a grandeur and a character of their own, and a strong claim on our attention by reason of their independant majesty and truth—a claim which has, indeed, been duly acknowledged in the well-known works of our countrymen, Hope, Whewell, Willis, and Pettit.

Although the types of many parts of these Romanesque buildings may be found in Byzantium —in the works of Greek artists, who had studied the arch and column at Rome itself—yet some particulars of their arrangement and construction may be derived from the early Basilicas of Rome. To the former may be referred the vaultings, the apsidal* terminations at the ends of the nave and transepts, the semi-domed roofs, the piers, the open cupolas and windows, as well as some peculiarities of detail. To the latter may be attributed the Latin cross shown in the longitudinal and transverse arrangement of the piers and arches—corresponding to the marble avenues of the Basilica, some arrangements of the apses, and many examples of flat roofs, carried by plain walls, pierced with small round headed windows. Indeed the campanile of Santa Francesca Romana† (Rome, A.D. 836), may serve as a type of those subsequently erected on the borders of the Rhine. The connection with the Byzantine types can be directly traced through the relation of Ravenna to that city. In 802 Charlemagne erected the cathedral at Aix-la-Chapelle (on the spot where a previous church was built in 543), in imitation of San Vitale, at Ravenna; and although this cathedral was altered in 983 by Otho III, yet enough remains of the base of the central cupola to indicate the style of the rest of the church. At this time in England, St. Paul's, Canterbury, Peterborough, and St. Albans, had been founded. Did the various edifices still exist which were successively erected on the site now occupied by the cathedral of Cologne, we should have a complete series, commencing from the year 94 of our era. Here Charlemagne built a church in 814 (a little later than that at Aix), another was erected in 873, and destroyed in 1248, in which year the present edifice was commenced.

It is through the works of the Lombards, in the church of S. Michele, at Pavia,‡ and elsewhere, that we must trace the connection with the *Basilican* type. In Italy this form is naturally reproduced in most of the ecclesiastical edifices of this period. The church at Pavia dates from 720 to 750; and St. Castor, at Coblenz,§ was consecrated in 836, by one who lived much at the former city. Not to mention that curious example at Lorsch (of which only a fragment now remains), consecrated in 774, in the presence of Charlemagne himself, we have, in the above-quoted instances, sufficient proof of the origin of the architecture of the Rhine. We shall see how it flourished for the next three centuries, and how, at the close of the twelfth and commencement of the thirteenth centuries, it attained its full growth under the protecting care of Frederick Barbarossa, at the very time when he was burning and laying waste the rebellious cities of Lombardy.

The less disturbed times in Germany, producing fewer warlike or palatial buildings, gave opportunity to its artists to lavish their talents on the ecclesiastical edifices of Prince Bishops, and the results can be traced even as far as Liege, in the Netherlands.

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* Yet we have in the majestic ruin of the Basilica of Constantine at Rome two apses—not opposite to each other, one being towards the Forum, and one towards the Colosseum—but this is of an age just preceding the birth of Byzantine art.

† Itself copied from an earlier one, by Adrian I, A.D. 772.

‡ "It is impossible not to see in Pavia the origin of the Rhine churches."—*Gally Knight.*

§ Louis the Pious consecrated St. Castor in 836; it was rebuilt in the latter part of twelfth century, but some parts were preserved.

Proceeding now to examine the particular arrangements which the three great cathedrals of Maintz, Worms, and Spires exhibit, we find that the grand central nave was universally adopted, generally vaulted in a semi-circular form; though pointed vaulting was very early introduced. The nave-piers are large and plain, and the arches round. Sometimes there is a triforium, but always a clerestory, with windows as in the aisles, narrow and round-headed. There are transepts at both ends, often with apsidal terminations, which are also seen at the east and west ends of the nave. Over the junction of the nave and transepts, we find a light, open cupola, generally polygonal, *not domical*. There are towers on each side of the apse. If only four, they are very nearly alike in size; though the eastern pair are somewhat smaller. If each transept also has towers, they become little more than turrets, though still of bulk and elevation enough to assist in the grand effect of grouping—as may be seen at Cologne, Maintz, Worms, Spires, Andernach, Laach, Boppart, and Coblenz. The high altar is approached by many steps, being raised over a crypt, half sunk in the ground, and generally supported by vaults on columns, exhibiting the best details. The entrance is sometimes through a cloister,* surrounding a square court. At Laach Abbey this exists entire. At Aschaffenburg there is an exquisite specimen of a cloister-court, though it is not now the chief approach. Many large churches have undergone such alterations, as to exhibit at present but few of these peculiarities of plan. At Augsburg, the tower alone remains; at Nuremberg and Munich, only portions of these general arrangements are shown; while around the latter city, and scattered over the whole plain south of the Danube, there are numerous little country churches which evince their relationship to this class of the Romanesque by their towers alone. Schwartz Rheindorf stands alone, with its peculiar double church—an upper and a lower one—under the same roof, a grand central spire, and hipped gables. It is, moreover, the best example of the circumscribing galleries. The cathedral of Bonn, being of the transitional period, is much Gothicised, and has some remarkable windows—which the church at Boppart also has. At Sinzig there is an admirable group, very much resembling that of St. Croix, Liege. The position of all these edifices was well chosen. Level tracts of country are more advantageous, perhaps, for the display of grand edifices than very undulating surfaces. The cathedrals of Maintz, Spires, Worms, &c., derive an imposing effect from the flatness of all around them, while the cathedral of Bamberg, raised on a slight hill overlooking the city obtains additional grandeur from its terraced front. Limburg is finely placed; but the secluded site of Kloster Laach is extremely beautiful, surrounded by abundant foliage, which extends over the surrounding hills, and encloses the still waters of the adjoining lake.

The constructive requirements for carrying the flat roofs, peculiar to the Italian and Basilican type, were simple; but in vaulting such spans as that of Spires (45 ft.), more care was requisite. Large piers, generally square, with pilasters or semi-shafts attached in front to carry the vaulting, bear the arches of the nave,—but between these great piers a smaller one is often placed, which, with the corresponding halves attached to the sides of the great piers, carries subordinate arches, and is continued upwards to form clerestory compartments beneath the great arch of the nave. This arrangement permits the sub-division of the vaulting of the aisles, (which are generally half the width of the nave) into two squares; and so long as only the semicircular arch was used, the square was necessarily the plan of every compartment or vault of the nave. When the pointed arch was introduced, greater freedom in this respect was obtained, and we see it used in the *transverse* arch at Maintz, and both longitudinally and transversely at Worms and Bamberg. The square vaulting of the aisles, and the intermediate piers were continued however long after this improvement, and I

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* Compare the Atrium at San Clemente, Rome; at San Ambrogio, Milan, A.D. 861; and at the Cathedral at Salerno.

consider this subordination of arches to be a feature, which, like the orders of tracery at a later period, gives great effect and lines of shadow, hardly to be expected in buildings with mouldings of so plain a character. The caps of these vaulting shafts are often boldly carved, as at Spires and Laach, and the latter even now retain some remnants of the colour with which they were originally covered. The impost mouldings of the arch piers are large and plain,—those of the subordinate ones are often not carried round the face in front. Most of these great churches have only a plain wall above the nave arches, or they sometimes exhibit smaller decorative arches beneath the clerestory. A gallery called "männerchor" or "mannhaus,"* formed with large openings and a floor over the vaulting of the aisles, has a decided correspondence with the triforium—a great feature of the later styles. England has many examples of the triforium, but, Boppart, Andernach, Sinzig, and a few other smaller churches, are all the examples in Germany; and it is decidedly a Byzantine feature, as is also the vaulting of the apses by semi-cupolas, instead of the groined vaults which succeeded. The position of the apse has been already mentioned, but it remains to state that smaller ones were occasionally built in the east wall of the eastern transepts, as at Laach and Sinzig,—(like the Basilican tribunals,) and in this case there are no north and south apses. The towers vary much in form, being square, polygonal, or round, and occasionally passing from one form to the other at the dividing stages; but their construction, or constructional ornamentation, is always the same. At the angle of the square, a strip of wall projects very slightly from the face. These flat pilaster strips, or incipient buttresses, are united several times in the height of the tower by flat bands or a series of mouldings, carried on corbel tables of small round arches. In the panels thus formed, roundheaded openings, single, double, or united under one common arch head, are inserted. Sometimes, in the centre of the wall, a flat strip corresponding to the projection at the angle, is carried up to join the horizontal string, and is often continued above it to the very top of the tower. The two series of panels thus formed are pierced by windows.

This system, (a decided Lombard importation, and seen later in our own Norman and early English,) is carried out in every wall. Cornices and eaves courses are supported on corbel tables of round arches. The apses, whether round, semi-octagonal, or semi-decagonal, are decorated in the same manner, the aisle and clerestory windows occupying the panels. Occasionally modified and varied round rolls are carried up the walls, and tied by horizontal rings of mouldings round the tower itself; a series of larger arches is sometimes carried round the walls on corbels only, without any vertical lines of support from below.† When it was required to cover a round tower with a roofed of a polygonal form, the transition was easily accomplished by one or more of these projecting arches on corbels, and in this arrangement we sometimes observe a point in the arch coinciding with the face of the wall, exactly as the Byzantine pendentive. The system was carried out even further by the introduction of the trefoil-round arches and multifoils of pointed as well as round forms, in later examples. Wherever we meet with a building of the Romanesque period we have this characteristic, common enough with us under the term corbel table. The Normans used small carved blocks, as well as corbel arches, and their successors carried out the principle. But in Germany these corbel arches seem to have been so highly appreciated that many complete Gothic towers are formed in this manner, which seems to be peculiarly applicable to brick constructions. The two towers of the Frauenkirche, (Cathedral) at Munich, 318 feet high, (built 1488) and other churches of the same city, have bands of ornaments of this character in carved or moulded brick. The Lombard churches,

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* Whewell, "Architectural Notes on German Churches," pp. 91, 92.

† Compare the tower of the isolated Chapel at Laach with the tower of the Church of Sompting, Sussex, of about equal proportions.

of course, show this system more or less, and even in the revival we see it carried out in unmatched boldness in the cornice of Florence Cathedral, and in the Campanile of Giotto, to say nothing of the extent to which it was employed in Italian brickwork.

In almost all the modern buildings in the neighbourhood of these early examples this feature is reproduced. In the towers or walls of Laach Abbey,* nearly all the peculiarities above-mentioned are to be seen, and the little detached tower in the grounds adjoining, may serve as a model to illustrate these remarks.

Exceptions prove the rule, and the church at Boppart, which is peculiar in many other points, has no vertical strip in the two towers, but one immense horizontal one, in the shape of a gallery, connecting them at the base of the spires.

In the roofing of these towers a peculiarity exists which has not been directly imitated in any succeeding style, the walls being finished with very high pitched *pediments*, the horizontal side or base of the triangle having mouldings similar to those which form the raking cornice of the roof. Here we see a remnant of Roman art, which was never carried further, the *gable* of a higher pitch, without the horizontal base, being universally adopted. The square ends of the walling, in any position, are finished in this manner, and the pitch of some of these pediments in the transept ends, is still more in accordance with the classic type. The polygonal walls of the apses have often each face terminated by a pediment, and octagonal towers, as at Sinzig, St. Croix Liege, and even the walls which support the immense spire at Bonn are finished in the same fashion. The ridges of the roof being carried up from the apex of these pediments, meet together at an acute angle, and thus form a kind of spire, terminated by a vane and an ornamental cross. The flat surfaces of the roof between the sides of the pediments and the ridges of the spire are consequently of a diamond shape, and when scored with the diagonal lines of slate roofing, have the appearance of being ornamented with scales, the slates being always rounded at the corners. The angle of these roof ridges varies, but it is generally acute, and more so the nearer the whole approaches the form and character of the spires of a later period.

In England, we have but one solitary specimen at Sompting in Sussex; but it is a perfect pattern of the Rhenish tower and spire. Whether the spires of St. Martin, Cologne, and Schwartz Rheindorf are original is uncertain,—but if so, they are the precursors of our common hipped broach spires, being octagonal on a square base. Along the banks of the river Maine, at the Pfarrkirche at Aschaffenburg, the villages of Erlenbach, Miltenberg, &c., are seen small, but more elaborate specimens, in which the octagonal spireis complete, with a rib springing from the base as well as from the apex of the pediment. On the borders of Switzerland, by the Lake of Constance, and the upper part of the Rhine—thence to Schaffhausen,—these forms occur, varied according to circumstances. But the pedimented spire is not the universal roofing for towers, but it is reserved for the better class, or the most important of a group. The ordinary eaves roof forms a square spire on a square tower, or a polygonal one on a polygonal base. The example of Laach gives the latter form on two circular towers at the west end and the eastern cupola; and the former on the two at the opposite end, while the square form of the west cupola, being the most important feature, and the highest of all the six, has four pedimented faces. Many examples of (now) isolated towers, occur on the Rhine, one large one near the mouth of the Lahn, nearly opposite the castle of Stolzenfels. It is to be remarked that during the whole of this period the character of the spire was essentially that of a *roof* or covering for protection, and it is not till a much later date that we see it assuming a more important ornamental character, and constructed solidly in stone. The later we see it, the more resemblance it has to those succeeding constructions, which were consummated in such masterpieces of gothic lightness and skill as Freiburg Minster.

* Damaged by fire within the last few months.

But there is yet another class of small country church towers, which are found in the plains round the cities of Augsburg and Munich, on the Danube, and towards the mountains of the Tyrol and Switzerland, of a form so common that twenty or thirty may be counted in a day's journey, and sometimes when an extensive view is obtained, at least half a dozen can be seen at once. Moyringen and Pasing are two of them, and they have simply two gables, instead of four, and an ordinary high pitched roof. The earlier examples have pediments and not gables. Some on the Rhine have a small gable in the centre of the tower, but this disposition is best seen in the four elegant spire-capped towers of Bamberg cathedral, which are carried up eight stages, and finished with gables and spires of a pink colour, (copper) surmounted by an elaborate gilded cross. Seven of these stages have corbelled bands and round-headed openings. An elaborate doorway is placed in the lowest stage on either side of the semi-decagonal apse, which is itself excessively rich in carved mouldings. The plain eaves roof of this apse, terminating on a cornice, *not* on a corbel table, butts against the face of the large gable forming the end of the nave wall, whose raking lines *are* carried on a corbel table of round arches, and which is pierced with plain round openings. This gable has its base at the upper string of the fourth stage of the towers, and is finished like the spires with an elaborate cross. The eighth or upper stage of these towers is of a later date, and corresponds to the chief part of the western towers to be further described. The plan of this upper stage is square, with the angles chamfered off,—or, rather, with semi-octagonal turrets added thereto, formed of shafts carrying pointed arches. The spires correspond in plan, being octagonal, but having the four sides at the angle less than the others, and the ridge does not spring from the apex of the gable which crowns each face of the tower. These gables exhibit a great deal of most beautiful work, and are formed by a boldly moulded and sculptured cornice, which is carried horizontally round the top of the semi-octagonal angles. The face of these gables is also elaborately pierced with three round arches, the centre one running to the top, and having a pinnacle inserted in its opening, and at each side above the other opening, a quatrefoil panel. The apex of each gable is crowned by an ornament, and the richness and lightness, combined with boldness of detail and elegance of proportion of the whole, are unsurpassed by any building of this class. Yet the towers at the opposite extremity are even more worthy of attention, as they have been rebuilt in this later style from the fourth stage, and so possess four stages of the form just described as terminating the twin towers at the east.

The lightness of these open angular turrets when seen in detail from the interior of one of them, or at a distance, when the sun setting behind them detaches the shafts and arches from the body of the tower, is an architectural triumph worthy of the noblest style of art.

The interior effect of the Romanesque churches is mainly due to the use of the open *cupola*, which is placed at the junction of nave and transepts, and though of various forms, always gives dignity and power. Acknowledged to be the redeeming feature of the Classic Renaissance, the grandest of the Byzantine and of the Romanesque, it is a matter of surprise that its value seems never to have been duly recognized in the later Gothic. The question of the Gothic dome has been frequently raised of late, and it is not impossible that the present century may see it satisfactorily solved.

At Laach, the eastern cupola is octagonal; the western one is square with pediments and a spire. At Sinzig, at St. Jacques, and St. Croix, Liege, the central cupola becomes a tower—octagonal, with pedimented faces, and a spire with ridges at the base, not at the apex of the pediments. At Worms, there is one cupola over the transept at the east end (flanked by round towers), which is octagonal, having an ogee shaped roof (not the original covering). Spires cathedral has an additional circular one at the west end, but it is difficult to say how much of this is original, on account of the

many disasters which have happened to this portion of the edifice. The cathedral at Maintz has an octagonal cupola at one end, of a highly mixed character externally; the base being decidedly Romanesque with the usual gallery; then a stage of later work, upon that another, with a parapet of a different style—the whole crowned by a smaller octagon, finished with Renaissance work; but the whole being built of the same peculiar red sand stone, has by no means an incongruous appearance at first sight.

The west fronts of many of these buildings are peculiar for the box-like form of the walls at the base of the cupola, carried down to the ground in square masses, and having a lean-to roof against the sides of the cupola wall itself; such is the case at Laach, where the heaviness is relieved by the gallery under the eaves of this lean-to roof. A church at Worms, St. Paul's, with a front partly in ruins, has a different arrangement, and though somewhat altered by succeeding styles, bears evident marks of the Romanesque. A parallelogram is set lengthways before the body of the church, with its cornice and roof elevation towards the street, and its gable ends (on raking corbel tables) towards the north and south. In the centre of this roof rises an octagonal cupola. On the north of this (and probably formerly on the south also), *behind* the block of the front, is a round Romanesque tower with four vertical bands and a cupola, at the base of which there are four pedimental lucarnes, or gabled dormer lights, placed *upon* the upper string or cornice, and not being part of it; a series of smaller ones ranges above these lights.

A church at Strasburg, St. Thomas, also has much of this arrangement in its west front, but a square tower, instead of an octagonal cupola, rises in the centre of the roof of the parallelogramic block, over a round headed door and circular window. The gable ends have more openings and a central buttress for part of the height, with an open gallery at the base of the raking lines of the gable, which has no corbel arches. In this tower, one stage above the apex of the roof is evidently Romanesque, with a cornice and corbel table, and an angular stair turret; but it is finished with later Gothic work of a plain character. Another church at Strasburg exhibits remains of this style. The front of St. Peter's Church at Munich, though much altered, presents a similar arrangement, but here the *tower* also is parallelogramic.

Nothing contributes so much to the lightness and gracefulness of character which some of these buildings possess, as the open galleries surrounding them on the exterior,* and in many cases in the interior also; this latter arrangement, shewn in the *männerchor* or triforium, has been previously mentioned. Small shafts resting on appropriate bases, and carrying grotesquely carved and foliated capitals, support small round arches, and form between themselves and the wall a passage way round the building, of which the church at Schwartz Rheindorf, is an exquisite example. The detail of the little columns will generally more than repay the trouble of ascending to examine them; every cap is different, and though frequently of grotesque design, often wreathed with delicate conventional foliage of bold and effective execution.† The cloisters very commonly contain shafts doubly set, as at Laach; an arrangement in which we recognize a close connection with the architecture of the South, as the Romanesque of Provence, Lombardy, and all Italy present this feature.

The window openings are of a very plain character; generally single, though sometimes double, or placed side by side; with or without an enclosing arch; in gables, or as a triplet, having the centre opening taller than the side ones, and a round arch enclosing the whole. The wheel windows, large

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* Compare San Donato at Murano, Venice; SS. Giovanni e Paolo, Rome; San Fedele, Como, Chiaravalle, near Milan, &c. &c.

† There is a tall tower-gateway at Spires, which illustrates the *effect* of these open galleries beneath cornices most happily: it is in itself a noble structure.

and small, though not a very numerous class, would in themselves form a very interesting study; in some, plain flat tracery is decidedly developed, akin to what may be found in Italy, when "Gotico Tedesco" was first imported at Assisi, A.D. 1228. But, besides these, the later examples, though still comparatively early in the style, exhibit a wonderful play of fancy in the form and arrangement of small openings. The little isolated tower at Laach contains a curious variety—trefoil, quatrefoil, fan-shaped, quatrefoil in a diamond, trelobed, and octagonal; but these are chiefly small openings placed beneath the round arches of the corbel tables.

In such transitional buildings as Bonn, Limburg, Sinzig, and Boppart, the aisle and clerestory windows exhibit a curious complexity of form, independently of the pierced tracery of the circular and wheel windows. The principle on which they are formed seems to be the surrounding a plain arched opening with splayed round foils, extending beyond a semicircle, the splay being continued below, as usual, parallel to the window jambs. A clerestory compartment at Boppart has a pair, each under a round headed arch, and connected by a square lined trefoil. The lower windows in the choir resemble the common escutcheon of a lock, but the range above has long round headed openings enclosed in a round archivolt, supported on shafts, which shafts also carry each side of the *round* or *pointed* archivolt, and this mural arcade is continued round the polygonal apse, grouped into one round and two pointed arches to each window, a double or clustered shaft being placed at the angle, or where two groups are connected. The arrangement has quite an early English effect, and the date is of about the middle, though the body of the church and towers date from the commencement of the 13th century.

The doorways, though generally of a plain character, are more often decorated than the windows; there are some elaborate specimens to be found at Bamberg Cathedral, in the eastern towers on each side of the apse. They are composed of diminishing orders of roll mouldings, carried on shafts set in the angles of the wall; most of these shafts are plain, though some are fluted and zigzagged as in our own Norman work. The two innermost archivolts exhibit star ornaments, and the capitals are enriched with carvings of angels and foliage. The north-east doorway, which is more elaborate, is formed like a porch, with a projecting corbel table, cornice, and roof. It displays eleven pair of nook shafts; the caps of six pair are carved to represent human forms, the remaining five have ordinary moulded and foliated caps. The north-west door is of the same character.

On looking closely into the details and mouldings of early German churches, we recognize the propriety of the term "Romanesque." In the cornices we find the hollow and round alternating, with the dividing fillet constantly occurring, while all the base mouldings follow the Attic type. The capitals, we admit, though individual and spirited designs, and of great variety, are often carved after Classic models; but the simplicity of the whole, and the richness attained, without the sacrifice of this great virtue, is a principle certainly not copied from the latter efforts of the Roman empire.

We cannot doubt that the interiors of these churches received the best decoration of the age. De Lassaulx, in his remarks on St. Gereon, Cologne, speaks of a church on the spot in 595, "named after the Golden Martyrs, probably because this church, like many others at that period, contained mosaic pictures on a gold ground;" and "Bishop Carentius is celebrated in a poem, as the restorer of golden temples." The present decagon of St. Gereon is decorated with color; traces of color also remain on the caps of the shafts, &c. at Laach Abbey. It cannot be supposed that large vacant spaces of wall would remain undecorated with fresco, when we remember how they were assigned in the Basilicas and Italian buildings of the same class as these, to display the powers of the artist. The spirit of revival in the present day and the spread of the arts at Munich, the capital of a state which possesses the largest Romanesque Cathedral, at Spires, have been the

means of restoring this last named building to something like its former grandeur, if not indeed surpassing in completeness any previous period of its existence.

Having now arrived at the limits proposed for this Paper, it is not without regret that I leave the theme, desiring to carry the sketch still further through the transitional period to the complete establishment of Gothic architecture in Germany—in the mighty cathedral at Cologne, at the very time when Romanesque artists were at work upon the church of St. Cunibert, A.D. 1248. But one building of the transitional period deserves a passing notice; though the churches at Bonn, Limburg, Boppart, and Sinzig—to say nothing of the later parts of the larger edifices, at Cologne, Coblenz, Andernach, &c. &c. — would each furnish ample materials for a separate essay. The apse of the church is all that remains of the once grand Cistercian Abbey of Heisterbach, begun 1202, completed 1233. Semi-octagonal above, but semi-circular below, it is divided into an upper and lower stage by a string of mouldings. The upper story is composed of five stilted round arches, pierced as windows, on shafts running into the groining and forming a five-partite vault, the groins meeting at the apex of the chancel-arch. The lower stage consists of five corresponding arches on detached shafts—but these arches are *pointed*. The shafts stand upon a low wall. The aisle wall is continued round the inner wall of the apse; and the passage thus formed is itself divided into two vaulted aisles by a series of detached shafts. The vaulting over these double passages with the outer walls supports the buttresses, which resist the thrust of the semi-octagonal vaulting of the apse. The whole arrangement is very pleasing, and the detail is worthy of remark. But I must not further continue this subject, however enticing, though I cannot but feel the imperfection of my sketch of the phase of Romanesque art which characterized the architecture of the Pre-Gothic Age in Germany.

Mr. G. G. Scott, Fellow, observed that in his visits to Germany he had generally been in search of architectural specimens of the thirteenth century, and had therefore paid less attention to the interesting edifices described by Mr. Hayward. He might suggest, however, as an interesting inquiry to antiquaries, an investigation of German architecture even before the period now referred to. For example, nothing was known of the architecture of the Franks between the days of Clovis and Charlemagne—a period of 400 years—which, so far as he was aware, was not illustrated by any existing remains. There were also very few examples indeed from the time of Charlemagne to that of Otho I. Many existing buildings—as St. Castor at Coblenz, &c.—were mentioned as *founded* in that era; but so small a portion of those buildings, as they now stand, were really of that date, that none but a very careful antiquary could find it. The accuracy of the term "Lombardic," as applied to this style of architecture, was also an interesting question. He confessed that he could not bring himself to believe in the great antiquity assigned to San Michele, &c. at Pavia, in which the style was supposed to have originated. These were ascribed by Mr. Gally Knight to the seventh century; but, inasmuch as the north of Italy was desolated by the Huns in the tenth century, and as the churches of Pavia so closely resembled those upon the Rhine, he (Mr. Scott) thought it more probable that Otho I. had been the originator of the early churches in both countries. The most probable date for the early Romanesque churches of Germany was the period of the three Othos (from about A.D. 960, to about A.D. 1000), although some of them were doubtless founded upon earlier churches. In fact, the *best* specimens of Romanesque in Germany were of extremely late date. He imagined that the church of Laach—referred to by Mr. Hayward—bordered upon the transitional period; and the best and richest specimens at Cologne were of the same date. The workmanship of the German Romanesque appeared to be far superior to that of the corresponding style [Norman?] in England;

but the style flourished in Germany till a much later date than in this country. The Abbey of Heisterbach (which was pure Romanesque) was, indeed, not finished till about 1230. Notwithstanding these facts, antiquaries had persisted in regarding the Gothic as a German style; whereas Germany was twenty years behind England, and at least fifty years behind France, in its adoption.

Mr. Lockyer, Associate, said that throughout France—and in the southern departments especially—there were remains of Romanesque edifices, much earlier in date than those of Germany, and exhibiting all the characteristics usually ascribed to Saxon architecture in England. He concurred with Mr. Scott, in believing the German specimens to be later than those of France and England. Central Italy presented some churches of a very early type, especially at Pistoia and Lucca. The church of San Giovanni, at Pistoia, had small circular-headed windows, and was entirely encircled with an arcaded band. The sculpture, also, was peculiar; and bands of coloured marble (chiefly green, or black and white) were introduced. Possibly these remarkable churches were of the time of the Othos; but they did not appear to have been imitated in the German churches. The style generally called Lombardic did not, in fact, appear to have been practised in Lombardy; and therefore the application of the term was a question for investigation. Mr. Lockyer, in conclusion, corroborated Mr. Hayward's remarks on the extreme beauty of the site, and the architectural effect, of the cathedral of Bamberg.

Mr. Twining, Contributing Visitor, made some observations upon the cathedral at Drontheim, in Norway, erected in the 11th century, which bore some resemblance to the German churches under consideration. It had a small (detached) tower or belfry of singular shape, with a cupola of Byzantine character. The appearance of Romanesque features in Norway could not be regarded without interest. Mr. Twining also referred to some churches situate between Stockholm and Upsala, founded about A.D. 1000, which resembled in character the Saxon remains in England. In one of these churches there was an inscription referring to the migration of the Swedes to Switzerland, a fact referred to in Schiller's "William Tell."

Mr. Papworth, Fellow, adverted to the curious fact (recorded in the Chronicles) that one or more of the Swedish Cathedrals were built by the men engaged on the church St. Germain des Près. He begged to ask for some further illustration of Mr. Hayward's opinion that the progress of architecture extended from Germany into France and Northern Italy, and so southwards. The churches at Coblenz, &c., frequently called Byzantine, were merely octagonal buildings vaulted, and not *domes;* and this he considered was a proof of their Frank origin.

Mr. Hayward said that he had been careful in deriving the origin of the Romanesque style from the antagonistic principles of the Basilican style at Rome, and the style of Byzantium itself. He did not derive the Romanesque of other countries from Germany, but spoke of its peculiarly grand development in that empire. Mr. Hayward referred to some dates in support of his views:—S. Sophia, Constantinople, and S. Paul, without the walls, at Rome, (both before A.D. 400) might be taken as the two types from which the Romanesque style sprung. S. Vitale, at Ravenna, was copied from S. Sophia, and the church at Aix-la-Chapelle, from S. Vitale. Charlemagne died in 814, and if he built the parts now remaining of Aix-la-Chapelle, and was also connected with Lorsch, he must have introduced the style into Germany. With regard to the churches of Pavia, he believed that the peculiar style of the ornaments and carving indicated a date very soon after the decline of the Roman Empire. S. Giulia, Brescia, S. Frediano, Lucca, and many other churches were assigned to the same period as the churches of Pavia, the 8th century and the connection between Pavia and the Carlovingian Sovereigns of Italy in the 8th century afforded, as he believed, a good reason for the introduction of Lombard architecture into Germany. Coblenz followed about 30 years after

Aix-la-Chapelle, and in the 10th century the great cathedrals of Worms, Mainz, and Spires, were founded, in all of which parts of the original work remained. In the Island of Torcello, near Venice, the cathedral and a neighbouring church, S. Fosca, presented respectively the distinct types of the Basilican and the Byzantine styles; although they were ascribed to about the same date.

The year 1100—the age of the 1st Crusade, is the great central date for the Romanesque development—while *in England*, Tewksbury Abbey, the Cathedrals of Gloucester, Worcester, Durham, Salisbury, Canterbury, Norwich, and the curious brick Church of St. Botolph's Priory at Colchester were in course of erection. *In Italy*, the Cathedral of Modena, &c. *In Sicily*, that of Messina, &c. *At Jerusalem*, the Chapel of Godfrey of Bouillon. *On the Rhine*, Laach Abbey, Maintz, Worms, and Spires Cathedrals, are supposed to have been in progress.

1125—a quarter of a century later, is the date of the Apse of S. Donato at Murano.

1150—after the 2nd Crusade, we have *in England*, Iffley and St. Sepulchre's Northampton. *In Italy*, the Baptistry of Pisa. *On the Rhine*, the Church of Schwartz Rheindorf.

1175—*In England*, the Galilee, Durham, and parts of the Temple Church. *In Italy*, the Tower of Pisa, and just before 1200, the Cloisters of St. Paul's without the walls, and St. John Lateran, Rome. *In Germany*, the Chapel at Murrhardt.

1200—just after the third and before the fourth Crusade—*In England*, parts of the Cathedrals at Lincoln, Ely, and St. Albans. *On the Rhine*, Boppart, Limburg on the Lahn, &c.

1210—*In England*, Beverley and Salisbury. *In France*, Amiens, Notre Dame, Paris, &c.

1220—*On the Rhine*, Coblenz, Sinzig, Heisterbach, Gelnhausen; *at Cologne* St. Gereon, &c.; *and in the Breisgau*, that marvel of the next style, Freiburg Munster, commenced after the 5th Crusade.

1230—We have the return of the German influence, southwards, and *in Italy*, the Church of San Francesco at Assisi, the first built in the style of the "*Gotico Tedesco.*"

Thus we see that the great consummation of the style at Boppart and Limburg, was about the year 1200, when England had made a great advance upon the Romanesque. After that period came Heisterbach, &c., and the style went on improving till the German taste was re-imported into Italy, in the Church of S. Francisco, at Assisi, about the year 1230. There could be no question that that church was built by German architects and German workmen; it was the first really Gothic church in Italy, and the parent of all the others.

Mr. A. J. Baker, Associate, read Mr. Hope's definition of the term "Lombardic."

Mr. G. G. Scott, said, that in respect to the buildings of Pavia, the difficulty was to ascertain what part of the existing fabric dated from the original foundation of the edifice. In our own cathedrals, only portions of the crypts were of the original date. One of the doorways at Pavia, ascribed to the 8th century, exactly resembled another from a castle in the Tyrol, to which the date of the 12th century was assigned. Mr. Hope, he believed, was the first to use the term "Lombardic," but, although the style to which it was applied had no doubt originated in Lombardy, it might be questioned whether it was the style of that kingdom *before the time of Charlemagne*. It might have been adopted at the re-edification of the churches of Pavia.

In reply to a question, Mr. Hayward stated, that the figures of lions or griffins supporting columns, &c., so common in Italian architecture, were not found in Germany.

Mr. Fergusson, Associate, remarked that, the history of Lombardic architecture had been more fully investigated by Rumohr, than by any other writer. In his work, a distinction was drawn

between the Longobardic and the Lombardic styles. Of the former, he stated, that no remains now exist. It comprised the buildings erected before the time of Charlemagne (from the 6th to the 9th centuries inclusive), but these, as Italy increased in wealth, were all pulled down and rebuilt. San Michele, Pavia, was, in Rumohr's opinion, erected in the 11th or 12th century, the materials of the previous church being employed, and these were in many instances reversed. There were many Romanesque churches in Italy, and a complete series of them might be found in the churches about Rome; but there were no *Gothic* churches in Lombardy till after the beginning of the 11th century. It should be observed, that the Valley of the Po and the Valley of the Rhine belonged to the same empire from the time of Charlemagne downwards; and the same style prevailed in the one district as in the other, the churches being nearly identical. It was not correct therefore to say, that the Rhenish churches were derived from Lombardy, or the Lombard churches from the Rhine. In England the case was different, our Norman architecture being clearly derived from France.

The Chairman (Mr. Penrose, V.P.) proposed, and Mr. Scott seconded, a vote of thanks to Mr. Hayward, which was carried unanimously, and the meeting adjourned.

The paper on the Architectural Medals of Classic Antiquity, read at the Ordinary General Meeting of the 16th April, 1855, requiring numerous illustrations, it will be published by the Author, T. L. Donaldson, Hon. Sec. For. Cor.

SUMMARY OF A REPORT MADE BY MONS. RÉMONT, ARCHITECT OF THE CITY OF LIÉGE, ON WORKS RELATING TO THE HEALTH AND PUBLIC UTILITY OF LONDON.

Communicated by W. L. Donaldson, Honorary Solicitor.

Read at the Ordinary General Meeting of the Royal Institute of British Architects, May 21, 1855.

In the year 1849 the attention of the civil authorities of Liége was directed to the rendering more healthy the crowded localities of the city, and to the improvement of the system of constructing the sewers; also to the paving of the streets, and the supply of water, as well for the service of public health as for use in private dwellings, and for the purpose of drinking.

The desire of introducing into these different parts of the administrative economy the improvements already realized in the neighbouring countries, especially in England, determined the College of the Burgomaster and Magistrates to propose to the Communal Council to send the Architect of the city to London, in order to study the system of public works of that great city, and to report on the various subjects all the information necessary to instruct the administration of the City of Liége with regard to works it was itself about to execute.

The Committee of Public Works decided that investigations should be made chiefly upon the following points:—

1st. The distribution of water.
2ndly. The different systems of sewers.
3rdly. The like of paving.
4thly. The like of lodgings for workmen.

Mons. Rémont departed for England, where he was engaged a considerable time in fulfilling, as completely as possible, the object of his mission, and on his return he arranged the numerous materials of information he had collected, and submitted to the Administration the result of his observations and of his studies.

In this his Report he states, that he had examined chiefly the distribution of water for drinking; the construction and the cleansing of sewers; the cleansing of the streets; the construction of the dwellings for workmen; the better mode of paving streets and pathways; the system of construction of privies and urinals; the establishment of baths and wash-houses; the service of fire-engines. In short, everything which relates to works for public health and utility.

The first chapter of his Report relates to the supply of water, and after pointing out that the chief cities and towns in England and Scotland had organized companies for the supply of water, he traces the history of the supply in London from Peter Morrys, who founded the works at London Bridge, under the name of the Southwark Company, in 1581, and which was done away with in 1823 and united to the New River Company whose works had been commenced by Sir Hugh Myddelton in 1613, up to the present day. He gives a detailed account of the various existing water companies, and their amount of supply, with very minute statistical tables of the quantity and species of services in all cases. He also gives an explanation of the quality of the different waters, remarking that, according to the laws of health, water for drinking to be good should be clear, colourless, without taste, without smell, fresh in summer, temperate in winter, should contain atmospheric air and a small quantity of bi-carbonate of lime; in short, should not hold in solution either organic matter or sulphates of lime, nor any calcareous salt, the carbonates excepted. And after some further consideration of the subject he states, that one would understand from thence that the waters of the Thames, which is considered, and with reason, the greatest sewer of London, could not, notwithstanding the purifications to which they were submitted, satisfy the conditions required for being fit for domestic purposes.

He describes the system of purifying the water in the reservoirs of the different companies, and also the additional plans for effecting this by filtration.

The details upon this branch of his inquiry are very full, as also upon the mode of supply, the high and low service, and the question of intermittent and constant supply.

This chapter is illustrated by three large plates of diagrams, and he sums up the chapter with the following observations:

"One sees, moreover, that the English begin to understand that a good supply of water in a city cannot be the object of a speculative affair; that a supply without limit ought to be made at the simple price of the cost of the distribution; and that it can only be efficiently organised, regulated, and carried out by the magistrates who are entrusted with the very important interests of order and of the public health."

The second chapter is upon the sewers. In this he describes the local position of London, the amount of its population, the number of houses, the extent of its streets and ways, of which he states three-fifths have sewers under them.

He gives a short account of the Commission of Sewers established in the reign of Henry the Eighth, and of the system of management of the present day; and he enters very minutely into the construction of sewers, their forms, their inclination, the system of flushing, trapping, and the cost of construction. He also describes the lately introduced tubular or pipe drains for connecting houses with the sewers. He gives a summary of various reports recently submitted to the consideration of the Commissioners of Sewers and the public, for more effectually draining the metropolis, and he adds tables and numerous diagrams of the forms of sewers and the modes of connection, as well those employed as those suggested. The whole subject of sewage is very fully entered into, but it is observable that the chief source of his information is drawn from a prejudiced quarter.

The third chapter is upon urinals and public privies.

He commences by observing, that householders in London consider the foot paving as forming in some measure part of their houses, so they keep it in a state of perfect neatness. Every where the vigilance of the police and the rigour with which it causes its regulations to be observed contribute greatly to this result; but this strictness produces this other result, that often when much pressed one rarely finds in London a place where one is permitted to make water. He observes that there are, however, some public urinals in some side streets, formed of two or three inclosures of stone, shaped according to the places where they are put; but he complains of these not being arranged in a sanatory manner, and that, although water is so abundantly supplied in London, and could be so easily introduced into the urinals, they are not washed with it, and that the urine escapes through gratings, leaving very offensive and pernicious exhalations. He praises, however, the mode in which these urinals are constructed, being enclosed, so that a party within is concealed from view, and there is an injunction written up for a decent arrangement of the dress before leaving. He praises very much the urinals in the London and North Western Railway station, as containing all the requirements for such a convenience, and he describes those in the Athenæum Club as excelling even the very good arrangement at the railway station. He describes also the public privy which was constructed, as an experiment, in the year 1849 in Rose Street, and among other systems upon this head he describes fully, and with explanatory diagrams, the plan proposed by Mr. Hosking for collecting the solid contents of the public and private necessaries.

The fourth chapter is upon the carriage ways and foot pavements, and in this he enters into a full examination of the granite paving, the wood paving, and the Macadamizing, which he says is called in Belgium "Empierrement." He minutely describes the two modes of laying the granite paving, the one in lines perpendicular to the axis of the street, the other in lines oblique to this axis, and in an angle of 45 degrees, and he enters into a full discussion of the subject, including in it the cost of the various modes of paving. He makes particular mention of the new mode of laying the paving at the London and North Western terminus, which he calls "pavage Taylor." With respect to the foot

pavement, he speaks highly of the pavements of London, and he considers that the mode of paving is one of the most important and most useful works that this great city has accomplished. He remarks that in some narrow streets, where two carriages could not pass each other without sacrificing the convenience of the foot pavements, the carriage way is lessened so as to allow of only one carriage to proceed, and a wide space, either at the middle or at the end, is left to admit one carriage to pass the other.

In chapter five he proceeds to describe the mode of cleansing the streets, and he traces the different modes of effecting this from the earliest times to the system of the present day. He describes the water carts, and the patent machines for cleansing which used to operate in Regent Street, and which were first used at Manchester, Birmingham, Leeds, and other large provincial towns, before they were so in London.

The sixth chapter is devoted to the important subject of the dwellings of the working classes, and he traces the history of their establishment. He remarks, that Dr. Southwood Smith truly observed that a house arranged according to the requirements of health and comfort, contributes essentially to the well being of the family; inspires it with ideas of regularity, of peace, and economy; causes to arise insensibly in it respect for order and the laws, altogether causing in it the knowledge of the necessity of fulfilling the duties that the social state imposes upon all good citizens.

He describes the formation of the Society for Improving the Condition of the Labouring Classes some years since under the patronage of Queen Victoria and the Prince Albert. He traces the progress of the Society in not confining its operations to the cities, but extending itself to the country and erecting model cottages, of which several designs are given. In his observations he shows how much is due to Mr. Roberts, the architect, for his attention to the subject, and he refers also to Mr. George Beck, the architect of the St. Pancras dwellings for families. As in the other subjects, the statistical tables are very full and instructive upon the different points of expenditure and the returns. The details as to the ventilation, the supply of water, the lavatories, and other matters, are likewise minute and clear.

A very full description of these dwellings is given illustrated with plans and sections. He traces the first steps of the Society in taking old houses and adapting them to the desired purposes, as in Charles Street, Drury-lane, and in Hatton Garden; to their building a model lodging house themselves, as in George Street, St. Giles's, where the Society could carry into effect their whole system of the supply of water, gas, and other conveniences, with the consideration, at the same time, of making the rent as low as possible.

Chapter seven is on the establishment of the baths and wash-houses.

He traces, from the first establishment of eight baths and twenty wash-houses at Liverpool, the progress of this system to the great establishments in London in the present day. The details upon this very interesting subject are very full and equally minute as on the other matters of inquiry, and are illustrated by many tables and drawings.

He calls particular attention to the extensive employment of slate in the baths and washing places, as a substance not susceptible of change by the influence of the hot and damp atmosphere, and not liable to be impregnated with deleterious or offensive substances.

The eighth chapter is on the expedients in case of fire.

He mentions the regulations in parishes, by Act of Parliament, to have two pumps always in good order, and in consequence of the insufficiency of the parochial arrangements, the subsequent establishment of the Fire Engine Brigade, which was founded and is supported by the different Fire Insurance Companies in the metropolis. He describes also the Society for the Protection of Life in Case of Fire. The details he gives of the Fire Engine Establishment and its system of regulation are very full, and interesting to those who may not be acquainted with its operations; and the engine used in London obtains his warmest approbation. The fire escapes also engage largely his attention.

At this part of the work he enters into a short account of the London Police, the whole system of which, and the conduct of the force, he warmly applauds. An extract from his work on this head will not be uninteresting.

" I was (he says) witness of a great fire of a warehouse, containing more than one and a quarter million of francs worth of wool, near Finsbury Circus, in the City, on a night of the month of October last. Scarcely had the fire been discovered when the first safety machine was already placed at the building, and the first fire engine, with all the speed of the horses, arrived there. In a few minutes they opened the water plugs, adjusted the hoses, and launched the water on the fire at the command of the sub-officer. Then arrived in succession many other engines and fire escapes, and in less than a quarter of an hour the burning warehouse was covered with water, thrown up as well from the street as from buckets carried to the top of the ladders. Although this building was connected with other warehouses of other kinds, and about twelve dwelling houses, the fire was so well concentrated that the adjoining buildings were but slightly damaged. It was at this fire that I was enabled fully to appreciate the strict organization and the duties of each of the three forces. The police, to the number of more than one hundred, commanded by a chief, occupied themselves exclusively in keeping order. They formed in an instant round the workers a ring, which could not be forced, and at such a distance that the voice of the commander could be easily heard. The police did not interfere at all in the works of the fire. Their mission was to maintain order, and to watch the spectators; to act so that the engines and ladders should have full liberty for their operations. On the other hand, except for working at the pumps or to assist in removing furniture, if that were necessary, no one was admitted to the works of the fire. When the ladders have no one to save, they remain on the spot to facilitate the access to the burning buildings. There results, in consequence, from this division of labour, an immense advantage. To restrain the spectators, whose eagerness and cries create disorder and distraction, and paralyse all the officers, is the duty of the police. It leaves to the firemen and the conductors of the safety ladders every freedom for their action, every facility in their movements. In short, every one acts with calmness, intelligence, and remarkable devotion to his duty."

The ninth and closing chapter is upon various subjects.

First, the improvement of the sanatory condition of dwellings, of which the drainage forms a subject of close inquiry and of very minute and lengthened details. The inscription of the names of streets does not escape this Architect's attention, and he particularly notices the enamelled porcelain lettering fixed into a metal frame.

The extensive use of zinc in the present day attracts his attention, and he points out the difficulties to be guarded against in the use of this metal on account of its expansion and conratction under different temperatures.

The subject of zinc is doubtless a familiar one to him from his acquaintance with the large works of that metal near Liége.

The object of calling attention to this work of the Architect of the City of Liége is not so much on account of any novelty of information it contains, because, in fact, the whole of the particulars he gives appears to have been supplied to him fully and liberally by the different architects, engineers, and officers, in London, connected with the Water Companies, the Commissioners of Sewers, and other bodies, and they are known to many, and might be known by all; but to show what appears to me a very systematic report upon the various works of a sanatory and useful nature in a great city; and in a comparatively small space it does, in fact, satisfy the mission upon which M. Rémont was sent. How far the authorities of Liége have benefited their city by the information so largely given is not stated, but every traveller will admit that Liége is far from being a model town in any one of the points which are so fully reported upon and practically illustrated by M. Rémont.

A FEW REMARKS ON ITALIAN ARCHITECTURE.

By the Rev. J. L. Petit, M.A., Hon. Member.

Read at the Ordinary General Meeting of the Royal Institute of British Architects, June 4th, 1855.

It is not to be expected that the observations of a mere amateur like myself will convey any fresh information to practical and professional architects; yet if I honestly record my own impressions, and do not merely retail the opinions of others, I may succeed in suggesting a new, and perhaps not unprofitable train of ideas even to the most experienced.

I have no doubt that much which has appeared to me new and remarkable is, to most of you, familiar and common-place; and that the views which I have entertained and which I would lay before you, are not presented to your notice for the first time; nor need I say that I avail myself freely of the works of other writers upon architecture; that I have been led by them to observations I should probably never have made of myself, and of course must be indebted to them for rudimentary principles, facts, data, historical evidences, &c. without end; still I shall draw my conclusions myself, and not take them ready-made from any authority at hand.

I much regret that I was not present at the last Meeting of this Institute, to hear Mr. Hayward's very interesting paper on Romanesque, of which I have just read the substance in your last Report. Had I met with it earlier, I should probably have framed my present remarks not without some reference to it.

When I express a doubt whether the present attempt to revive the Mediæval styles be favorable to the promotion of architectural taste, or to the advancement of architectural art, I trust I shall not be accused of insensibility to the wonderful beauty of Gothic architecture, nor yet of indifference to the merit of a considerable number of modern buildings of that style, some of which I have had an opportunity of studying lately, and cannot but admit the excellence of their design and execution. In some, the architect has not only traced the details, but caught much of the spirit and character of the age from which he has borrowed his style. At the same time, I cannot look at such works in any other light than as spirited and successful imitations. Their excellence appears to be just proportioned to the closeness of the imitation. I am occasionally told that the advocates of revived Gothic look to, and aim at, a fuller development of the system. If it be so, and if they have a fair prospect of success, my argument falls to the ground; but I do not see any symptoms of this development; any aiming at a higher standard than has already been attained. And under such circumstances, it cannot, as a national style, possess that vigour and energy which are the very essence of true Gothic. I am hardly prepared to admit that the Gothic style was the natural and inevitable result of the arcuated system. It seems more correct to say that it was struck out of it by the genius of a peculiar race, who in other respects are remarkable for their influence on the destinies and condition of the greater part of Europe. But for the Normans the use of the arch, even of the pointed arch, would never have given birth to such productions as Amiens, Strasburg and Salisbury.

I need not remind you that an arch may have two kinds of abutment—one, a solid, immoveable mass, which would stand independently, though the arch were taken away. The other, an arch, or portion of an arch, pressing against that to be sustained, and if the latter were removed, liable to fall in. This constitutes the grand distinction between the Gothic and Roman. For though but a small proportion of Gothic buttresses are actually flying buttresses, that would fall in if the arch strength-

ened by them were removed, still all the buttresses have apparently that tendency, and are made to indicate an active pressure, while the Roman abutment is a solid vertical mass; (each pier is itself an abutment); and to give a greater appearance of stability, an engaged column or pilaster is attached to the pier, and an entablature carried along the top of the order; broken or not by projections corresponding with the columns. Undoubtedly this is an incongruity in composition, but it may be less severely condemned on account of the expression it gives of repose and tranquillity; an expression, you will observe, proper to architecture itself, independently of the spirit and character of the age or people. And although it is most strongly marked in ancient work, it is by no means lost in the lighter compositions of the revival. The Gothic expression is that of movement, energy, conflict; elements of grandeur, so long as they represent a corresponding spirit of the age, and giving amazing life and force to an architecture that sprung up in times characterised not only by earnestness and strength of purpose, but also by a considerable degree of restlessness, turbulence and violence. The attempt to adapt it to an age of advanced civilization and refinement may possibly result in burlesque, and almost certainly will result in tameness and insipidity. A style suggesting repose (and this also is an element of grandeur) cannot be out of place at any time, or with any people, because it belongs essentially to architecture itself; a style suggesting movement and conflict (which are not the natural characteristics of architecture in the abstract) must be out of place unless it conveys a true and lively expression of the spirit in which it originates And this appears to me the principal reason why modern Gothic buildings fail to command that amount of interest, which the intrinsic beauty of the style, and in many cases the excellence of the work itself, would seem calculated to excite.

Though I have remarked that something may be said in justification of one of the most manifest inconsistencies of the Italian classical style, I by no means assert that we should not get rid of it if we can; and I am farther still from defending the debasements which undoubtedly have tended to bring this style into contempt. That much poverty of invention, meagreness of design, ill conceived and unmeaning ornament have marked some of its stages, it is impossible to deny. In a hasty excursion that I lately made through some parts of Italy, it struck me that works of the revived classical of the 15th century were of great interest; those of the 16th mostly worth study; those of the 17th of comparatively little value, while in the 18th a decided improvement took place, though not without considerable coldness and formality of character. The principal front of the Lateran will explain what I mean. In France and Germany, we shall hardly find buildings of the same purity with those of Italy belonging to the 16th century; but in those countries, as in England, the lingering of the Gothic element gives a degree of picturesqueness to structures very faulty in their design. Of some of the earlier specimens in Italy I will speak presently.

If we must necessarily consider the pointed arch as a refinement and improvement upon the round arch, then it would be a barbarism to go back to the latter. But I do not think we are at all bound to admit this. The pointed arch may in some positions be more appropriate; but it is by no means beyond dispute the better form of the two in the abstract, either as regards beauty or strength. The variety which the pointed arch admits has been much insisted upon. But the variety of angles made by the points of the arches is, I think, the last thing to which we should attribute the beauty of a Gothic cathedral. And though in a recessed pointed doorway every order has a different form, still I think many will prefer the majestic sweep of the round arch of many orders (all of the same form), as it appears at Tewkesbury and Tutbury. It seems not very easy to prove that the pointed arch is invariably stronger than the round. Certainly, in engineering works, the number of pointed bears no proportion to the number of round arches. There are many beautiful Mediæval bridges which

present the latter form. That of Kirby Lonsdale for instance; and on the continent the fine Pont St. Esprit over the Rhone, and the ruined bridge at Avignon. To find out the strongest form of an arch must be an extremely difficult problem; for its conditions will vary according to the supposed action of the weight supported; that is, whether we consider it as a solid mass, or as one acting like a fluid perpendicularly to the curve of the arch, or as a number of detached columns bearing vertically upon every point. I suppose the real action is a combination of all three; and I cannot see how mathematical calculation can give any decided practical rule. Probably, in most cases, neither the pointed arch, nor the unbroken circular arc, is really the strongest, but something rather of the form of the parabola, or the catenary, which the curve most commonly used for tunnels appears to resemble. I can conceive the pointed arch to be the strongest only where there is a decided weight upon the vertex, such as a pinnacle; and I should even doubt whether a gable required in the arch below more than a maximum of curvature, not amounting to a curvature greater than any that can be assigned, or in other words, a finite angle.

But experience teaches us that there are few cases in which we may not use the round or the pointed arch at pleasure, either being amply sufficient for the purpose required. The construction of several of our old market houses (that of Ross you may remember as an example), shews that arcades of round arches supporting a considerable weight, can be used with very little abutment. If then, the pointed arch is not a more pleasing form in the abstract than the round arch, not more desirable as a general rule, on the ground of strength, there is no reason why its introduction, at whatever period, should drive the round arch out of the field, or render its adoption obsolete and barbarous. The pointed arch was necessary for the perfection of a particular style, namely the Gothic; but is it impossible that a perfect round-arched style should be developed, possessing quite as high architectural qualities, and equally capable of expressing the genius and character of a people? There seems to me to be greater room for the further development of a round-arched style, than there is at present for that of a pointed style; for no round arched style has been hitherto carried out with that purity, or to that perfection, which almost every remnant of it suggests as attainable. The Roman style admitted the trabeal element much too freely. The Basilican, though purer and not unimpressive, is somewhat meagre, and depends more on pictorial than architectural ornament. The Byzantine promises well, and would form an admirable groundwork. The Pisan, with its multitude of small arcades, betrays a want of architectural invention (I do not say a want of invention in carving and coloured decorations, but I wish to speak of architecture as much as possible independently of other arts). The Lombard is grand but rude. The French and German Romanesque have much that is excellent, and in the 12th century shewed a considerable degree of refinement. The Norman, on either side of the Channel, is a noble and powerful style, but has so much of the Gothic element that its progress could only lead to the Gothic itself. A great deal already exists that might be available towards such a style, supposing it to be a desideratum; and if we followed it up with energy, it is not impossible that some hitherto unknown element, necessary to give unity, individuality, and decided character, may yet be discovered. I believe I am now and then accused of advocating some unaccountable jumble of styles, made up of Romanesque, debased Gothic, Cinque Cento, and Roman, and revived Italian of every class. Now, I would answer, that there is a great difference between obtaining suggestions from these, or fifty others, and mixing up their characteristics. For what I want to draw from these suggestions, are true and essential architectural principles, and not the mannerisms of style. I do not want the result to remind you of Romanesque, or Gothic, or Italian, any further than by possessing abstract architectural merits belonging to each or all. And the careful study of them will enable us to distinguish between sound principles and SUPERFICIAL distinctions.

I will now call your attention to a few of the earlier buildings of the revival which have struck me. The cathedral of Rimini, the latest part of which belongs to the fifteenth century, is well known to you by Mr. Gally Knight's work on the ancient architecture of Italy. The church is Gothic, but attached to its outer wall, is an arcade of round classical arches on square piers. The front, which is unfinished, suggests a very grand design. In this, the ornamental system of the engaged column and entablature is used, but the arcade round the rest of the church is without it, and exhibits in fact the round arch in its purity. I do not think I am acquainted with a grander specimen of the revived classical, as far as it goes; but these arches were built for a particular purpose, namely, to form a canopy for tombs ranged along a rich basement, and the structure would not sufficiently help an architect who is designing a cathedral.

When I was taking notes of the church of S. Paterniano, at Fano, between Ancona and Rimini, I was under the impression that it was a Romanesque building very slightly modernized; the strings round the pier at the spring of the arch, being the only features, if I recollect, by which I could detect revived Italian. Had I examined the exterior first (in an Italian town you often go into a church without a notion of what it is like externally), I should have come to what I take to be the right conclusion; namely, that the whole building is a work of the earliest revival, and one of great purity, but on the whole rather plain. The square central tower masks a dome upon Byzantine pendentives. The nave, transepts and choir, have cylindrical vaults with wide ribs at intervals. The choir ends in a polygonal apse, with a semi-domical roof. The aisles have a series of domes on pendentives, the compartments being divided by broad arches of a single square order. I have no recollection of any system of pilasters or engaged columns with entablature; at all events, none takes any prominent part; and the whole composition might easily be pronounced Romanesque. This is a fine church, and well deserves attention.

There is a little church on the top of a rock at Amalfi, which may be either Romanesque or revival; I have no notion which. I am inclined to guess the former, but only because the west front is not of the usual type of Italian west fronts of that district. In fact, the work is so plain, that there is nothing to mark a date or architectural style. The aisles have cross vaulting, and are terminated eastward by an apse, as is the main body; they are separated off by plain round arches of one square order with square inposts, having no capital or string. The central part of the church has a cylindrical vault, from which springs a dome on pendentives, resting on the crowns of arches instead of their piers as usual. There is no outer roof, the shell of the vault performing this office.

There is a fine church at Padua, near the railway station, which retains in its east end some Gothic work, but is mostly of revived Italian, no doubt of a very early character, and with somewhat of a Romanesque air in parts. The nave is very wide, and has a cylindrical vault with cells falling into it below the apex. It has no aisles, but a series of apsidal chapels, which shew externally. The dome rises from a square base, from which project pediments on three sides, the nave being the fourth. The projection, however, is hardly sufficient to form regular transepts. The chancel is much lower, and has Gothic work; attached to one side of the chancel is a plain square campanile. The building is on the whole pretty free from classical incongruities (I mean the column and entablature occurring among arches); though the exterior of the nave, struck me as being rather modernized.

S. Giacomo, Bologna, retains more of the original Gothic, having a good front of about the 13th century, but the building owes its present character mainly to alterations of the very early revival. It is by the way worth while to study the brickwork of this church, and to compare that of the Gothic with the later. Here and there it is difficult to distinguish the two; but generally, there is a closeness, clearness, almost a polish, in the earlier material, which marks its superior quality. And it will probably be found to be a good criterion of date, where architectural marks are uncertain.

But it is with the revival work we have now to do. The nave is without aisles, but has internal buttresses, which give space for side chapels. It is divided into three compartments, each of which is covered with that kind of dome, which is formed of the same sphere with its pendentives, and of which I have sometimes spoken as the Bernay dome, not being acquainted with its technical name, from its occurrence in the old abbey of that town in Normandy. Eastward of this is an octagonal cupola, the transepts to which do not project beyond the walls of the nave, nor do they make any shew externally. The side wall of the nave exhibits a series of segmental arches, not pointed, of two square orders; some of them contain lancet windows. Above these are four wide round arches, corresponding with the bays of the nave and the cupola. These are moulded, and are manifestly an addition to the original plan. The east end of the church is apsidal with an aisle. The tower attached to the south side is a tall, square campanile in several stages, with round arches. The upper stage seems to belong to the early revival.

St. Sebastian, in Venice, visited on account of the pictures of Paul Veronese, has to the eastward some revival work of a very Byzantine look. It presents a small cupola, nearly swamped by the nave.

In all the examples I have named the architectural style is of great purity, free from incongruities, and of a refinement not found in ordinary Romanesque buildings; adapted also for the introduction of fine sculpture and painting; but without them rather deficient in ornament, and perhaps not suggestive enough of a good system of architectural decoration. I might add some of the examples that more immediately succeeded the classical styles, such as the round church of S. Constance, near Rome, and others of the same description; or even the domical temples of Minerva Medica in Rome, Tussis at Tivoli, Venus at Baiæ, &c., which in their present state exhibit the round arch in its purity.

But an examination of many buildings in which the Italian system of ornamentation is regularly carried out, may furnish us with some excellent ideas as regards composition. The church of S. Giustina at Padua, evidently having for its pattern the neighbouring church of S. Antonio, presents a fine alternation of arch and dome; and in its accessory trabeal system employs the pilaster, always less objectionable in this position than the engaged column. But as a composition I rather prefer the Cathedral of Padua, which has only two domes, separated by a cylindrical vault springing from a mass which contains two arches with pilasters between them, and crowned with an entablature; a similar space intervenes between each dome and the corresponding end of the church. The imposts of the arches are here plain, instead of being, as in S. Giustina, repetitions on a small scale of the large pilasters. The recurrence of fine architectural masses at large intervals, a mode of treatment exquisitely carried out in the model of St. Paul's, appears to great advantage in the church of S. Salvatore in Venice, one of the most striking interiors, after S. Mark's, in that city. Another church in Venice (I understood it was S. Chrysostom) has a square plan comprising a central dome and pendentives, four cylindrical vaults, and four domical compartments at the angles; the central compartment is supported on four not very massive piers; the whole construction being arcuated and domical. Some apsidal and other projections give additional variety to the interior, which is an extremely beautiful one.

Palladio's churches in Venice have good outlines, but his fronts are unsatisfactory, and in the interior he is too fond of the engaged column. His general proportions, however, are very pleasing.

A careful study of the early works of the revival is calculated, you will readily admit, to enable us to clear the Italian style of all that is really base and meagre, and render it a style in which a great architect may express his thoughts, without the fear of being ashamed of, or much dissatisfied with, his work. But it may prove more difficult to clear it of those elements which, whatever reasons may be

produced to justify their introduction, cannot but be felt to be incongruous, and yet to command such means of enrichment as are necessary to ensure the magnificence of which architecture ought always to be capable.

A Gothic structure may be rich and magnificent by the mere help of mouldings, without the introduction of any sculpture, even so much as a wreath of conventional foliage. Some of our Cistertian abbeys illustrate this. And the Temple of Pæstum, now denuded of all adventitious ornament, and probably never enriched with much sculpture, proves that Greek architecture is in itself, even without the aid of any other art, sufficient for works of the highest grandeur of effect. Nor is the Roman style, whether ancient or revived, dependent upon sculpture or painting for its magnificence and beauty; and I have purposely selected examples which owe their excellence to neither.

If we attempt any new style we must take care that it be equally independent, though at the same time equally able to avail itself of the highest efforts of the sister arts. So that a mere surface decoration of sculpture does not solve the problem. And the use of unmeaning lines or mouldings to fill up blank space would be a sad falling off from the nervous and powerfully expressive Gothic.

It strikes me that the clear, delicate line of a semicircular arch requires a rectangular edge to mark it out properly, and consequently that it never appears to greater advantage than in plain square orders. A large torus confuses the outline, nor does a chamfer preserve it with sufficient distinctness. A sharp edge, or at the most a small bead, seems to be the proper finish.

If the soffit is full of mouldings, it takes the nature of Gothic; and any other ornament that varies the surface, such as the octagonal pannels in a Roman vault, is objectional as interfering with the strength and solidity of the voussoirs, which require that the inner surface of arch, vault, or dome, be unbroken.

As the arch is a constructive feature, invented for the purpose of bridging over spaces beyond the reach of a stone lintel, or where such could not be conveniently obtained or applied, I might suggest that it should not be used on a minute scale, where a piece of stone, or even a brick, is sufficient to serve the purpose; nor am I certain that the use of small ornamental arcades should be advocated. There is a difference between making the accessory details harmonise with the construction, and making them repeat it. I would suggest that the use of the shaft or column be abandoned, except where it can be perfectly insulated, and of something like classical form and proportion. Vertical lines may be obtained by pilasters, and these can be enriched by fluting, as in the Cathedral of Autun, a building which, though its pier arches are pointed, furnishes many admirable hints for the formation of a round arched style.

If the entablature be recognised, it ought, I think, to be somewhat modified, and confined to two members only, under the spring of a barrel vault; the architrave seems unnecessary except to connect a series of columns.

There is also a test which the composition ought to bear, which I shall call the test of reduplication, and endeavour to explain it. Set a spire upon a tower, and put a pinnacle upon each angle, also terminating with a spire. This may in its turn be surrounded with similar pinnacles, and so on without limit. Your work might soon become too minute to be carried on; but still it would involve no absurdity or impropriety; the original design bears the test of reduplication; we cannot object to it as either involving or suggesting any architectural anomaly.

So again, upon a mass pierced with one arch place one pierced with two similar arches, their imposts bearing the same ratio to the void spaces as in the composition below. On this again place a series of four arches; above that of eight, and so on. You may, as before, soon stop from the

minuteness of your work; but carry on your structure as you will, it involves no architectural anomaly; and a design suggesting such repetition or reduplication is in this respect not faulty. But now take an arch with square* imposts; pierce these imposts with arches; the imposts of them also with others, and so on, then we find that we are constantly lightening and weakening the substructure of a heavy mass; and the work that suggests this reduplication does suggest an architectural anomaly, and is therefore faulty.

The arch of Titus or Trajan, with its unpierced imposts, suggests no such reduplication, and consequently is so far correct; but where the impost (stripped of its columnar features) is pierced, the reduplication is commenced; and unless there are points of difference sufficient to turn the mind from the idea that it may possibly be continued, I think the arrangement is faulty. Perhaps the pierced piers of Perigeux are almost open to this objection, unless there be marked with sufficient clearness the difference between the soffit of an arch, and the surface of a vaulted roof. In the model of St. Paul's, the piers are not pierced, but merely hollowed out into a niche; a distinction quite sufficient to avoid the suggestion of any erroneous principle.

You will say that I am only raising difficulties to the formation of the style I would recommend. Perhaps it is so. I feel I am addressing persons more likely to be urged on by the knowledge that there are difficulties in their way, than by an assurance that all before them is plain and easy. It is the province of genius to surmount difficulties. An art beset by no difficulties is no art at all; or at least not one worth attaining. Poonah-painting has fallen into disuse. Potichomanie will, if I am a true prophet, scarcely outlast the present century; and such architecture as consists in mere imitation, whether its model be Gothic or classic, may not be destined to boast a much longer period of endurance. It is not from a mere desire of novelty that I am anxious to see a new style attempted. The Gothic, admirable as it is, appears to be so essentially connected with the spirit and character of the age which produced it, and to owe so much of its value and interest to the expression of that spirit, that its general revival in a different age, notwithstanding its successful adoption by individuals, seems to be morally impossible.

The classical, though not open to the same objection, and having many excellences, still contains certain essential defects and incongruities which prevent our remaining perfectly satisfied with it. A mere recurrence to English or French Romanesque, or a reproduction of German or Lombardic forms, would be an outrage to art herself, who demands constant progress even if it be towards decline, and if she collects the elements of an earlier period, still moulds them into something new and striking.

And therefore I believe that a path is still open to inventive genius, and however I may have failed in finding it out, I cannot be wrong in endeavouring to urge others to persevere in the search.

Mr. G. R. Burnell, Visitor, expressed his high estimation of the value of Mr. Petit's paper, especially in regard to the ideas which it necessarily gave rise to. Perhaps the most fruitful portion of that gentleman's remarks were those relating to the recent mania for reviving mediæval architecture. It had been observed by a celebrated French philosopher (M. Cousin), that the revival of a past style of architecture was in itself an anachronism, and a step backward. Beautiful as the Gothic style was, as a fine and noble exponent of the tone and feeling of that epoch, it was not adapted to the stiff and formal notions of the present day, which had nothing picturesque in its aspect or associations. Besides the evil of becoming enslaved to a mode of thought which was not that of the present age, the habit of blindly copying a previous style was open to the objection that the sam

* Piers.

circumstances which led to its adoption as the "fashion" of the day, would lead to the adoption of some other "fashion" which would supersede it. Thus he himself remembered the last glimmerings of the style of the Adams; then the mania for Grecian art; and now the Mediæval mania was predominant. Victor Hugo had said in one of his novels, that the feelings of a nation might be detected by a person who knew how to observe properly the handle of a door. That remark however would hardly apply to this country, where we had Grecian post-offices and Gothic churches,—neither being in consonance with our national habits. The most recent street architecture of the city of London, as exemplified in New Cannon Street, shewed a remarkable improvement upon King William Street. In the latter, the style adopted under the management of Government was bald and tame; but in New Cannon Street the architects employed had displayed considerable invention and talent, and the general effect of that street was very good,—although perhaps some fault might be found with every house. With regard to the use of different kinds of arches for different purposes, Mr. Burnell observed that the round arch was preferred by engineers, because all the voussoirs could be cut from the same mould, and because it admitted of the employment of materials of the same uniform character—such as brick. The parabolic arch had been used with great success in the aqueduct of Lisbon, erected at the beginning of the last century by a Portuguese engineer, but generally attributed to the Romans. With regard to the reduplication theory it was not yet fairly before the Institute, and therefore no decided opinion could be expressed upon it.

The Rev. Mr. Petit further explained his views on this point. Wherever the reduplication suggested a system which might lead to an absurdity, the composition was faulty.

Mr. Burnell then observed, in relation to the mural decorations of the churches of Pisa, &c. referred to by Mr. Petit, that architectural historians had not sufficiently called attention to the causes which had led to the architectural peculiarities of different countries. For instance, the course of each river in France was marked by a different variety of the national architecture—the buildings on the Loire and the Saone being respectively different from those on the Seine and the Oise. Again, fiscal regulations had a special influence on architecture. At one period a duty was levied on all stone quarried; and hence, even in stone-producing district, as at Caen and elsewhere, the houses of that period were built of wood. The case of the Mansard Roof, referred to at a recent meeting, was another instance of a novelty introduced in consequence of a municipal regulation of the city of Paris.

Mr. I'Anson, Fellow, was of opinion that no single individual had ever invented a style of architecture, and that no suggestions which might be offered could induce the creation of a new style, either from the round arch or the pointed arch. In past times it had required centuries for the perfection of a new style. He did not remember the passage in Victor Hugo referred to by Mr. Burnell, but in the beginning of "the Hunchback of Notre Dame," that author had observed that "in the style and form of its architecture might be recognised the spirit of a people." He (Mr. I'Anson) believed that to be the fact, and that whilst we were now copying Greek and Gothic indiscriminately, the historian of a century hence might look back and trace the feeling of the age by the different styles which now prevailed. It was an extremely difficult thing to copy even a Gothic building, from the associations arising from the objects daily around us, and from the still lingering traces of other styles as well as of the Greek mania. In spite of themselves the objects they saw around them crept into their productions, and thus the architecture of the age had a character of its own, which would hereafter betray the feelings and tendencies of the age. We were now as progressive a people as ever, and evinced as much invention and as much anxiety to attain novelty and greatness in art as ever; and he hoped some creditable result might be arrived at.

Mr. T. L. Donaldson, H.S.F.C. observed, that the important and suggestive nature of Mr. Petit's remarks, made it difficult to comment upon them without time for consideration. The tendency of the paper to produce greater freedom from educational prejudices was not one of its least advantages. It was evident that the great secret of the success of the Italian architects was the perfect liberty which they had of making designs, and forming a new style, and introducing any novelties that occurred to them. The school of art in England on the contrary, was much oppressed by the critics, and the Italians might be congratulated that they had not an Ecclesiological Society to cavil at their proceedings. He believed there was a sufficient desire on the part of the architects of England to introduce novelties, but in many cases their employers were not sufficiently advanced to sanction it, and they were accordingly compelled to adhere to routine. He had often experienced this difficulty in endeavouring to break through the trammels of the criticism and bigotry of the present day. The distinction between the pointed and the round arch styles was clear and definite. There was an up-rising principle in the former which carried the idea and imagination upwards far more than in the latter; and these abstract ideas should be borne in mind in considering the impressions produced by buildings of either style. No doubt, the pointed style was easier than the round, in point of construction; and he believed that all styles, from the Egyptian to the Mediæval, had been adopted rather for constructive than for æsthetical reasons. The round arch system prevailed for six or seven centuries, but afterwards a constant progress was to be traced, and there was no marked style which existed for more than a century. A remarkable unity and identity was to be observed in the round arch style throughout Europe; in Spain, in France, in England, in Germany, in Lombardy, and in Byzantium, the elements were the same, the difference being in the ornaments. This identity could hardly be accounted for, except upon the supposition, that there was a brotherhood of Freemasons dispersed all over Europe, possessing the same ideas of art, and the same amount of skill. Municipal regulations also, as Mr. Burnell stated, had affected architecture. The window tax, in its operation in this country, was a familiar proof of the latter fact, and our architecture had been in consequence characterized by the employment of small and mean windows. The duty on bricks and glass, in like manner, had a serious effect on architecture. Freed from the operation of criticism, and municipal regulations, he was satisfied that there was sufficient originality in the British mind to render the buildings of London, in the course of the next half century, such as to be able to compete with those of any other capital in Europe.

The Chairman, Mr. E. C. Penrose, V.P., made some remarks on the great value and importance of Mr. Petit's paper. It was evident that that gentleman rested with the greatest satisfaction on the genius of Alberti, especially as developed in the cathedral of Rimini. The cathedral of Mantua was equally interesting, and indeed all the works of Alberti, displayed a fitness which entitled him to the highest praise. It appeared wonderful indeed, that Alberti should have so far carried out a style, with which so little progress had since been made. The Pisan style appeared to be the weakest of the round arch styles, but it displayed a number of most exquisite details. The re-duplication theory deserved particular attention; beyond which, however, it might be premature to say anything. Mr. Petit had indicated a course of thought and study. The path was open to a new and finer style, and its attainment might be a hope to animate those who did not despair of the age. No style which had obtained life and permanence had sprung from new fangled ideas, but from some previous form. Thus, although the Greek temple had been elevated and refined in form and detail, the form of the original wooden structure which was its type might still be traced in it. All architecture, as Mr. Donaldson observed, had grown out of some constructive considerations, and been modified by climate and municipal regulations. As new materials were introduced, so archi-

tecture would be modified. No doubt, the architecture of the present age had its peculiar characteristics; as that at the end of the last century was marked by a degree of exceeding weakness and meanness. When such buildings as St. George's Hall, Liverpool, were erected in England, and when such valuable remarks as those of Mr. Petit were submitted for public discussion, there could be no reason to despair for the prospects of architecture.

A vote of thanks was given unanimously to Mr. Petit, and the meeting adjourned.

AN ENQUIRY AS TO THE METHODS WHICH IT IS MOST ADVISABLE TO ADOPT IN THE METROPOLITAN BUILDINGS BILL FOR REGULATING THE THICKNESS OF WALLS.

By Robert Hesketh, Fellow.

Read at the Intermediate Ordinary General Meeting of the Royal Institute of British Architects, June 11, 1855.

In submitting the following observations I must ask your kind consideration for any shortcomings in the enquiry, arising, in part at least, from the uncertain shape the propositions to be investigated have hitherto taken; but I hope my omissions will be supplied by the science and experience of those I have the honor of addressing.

Together with other district surveyors, I feel deeply anxious that the Bill for the regulation of the Buildings of this vast Metropolis should be efficient, and at the same time acceptable to the respectable part of the public immediately interested in it; and yet from the shape in which it has been brought forward, I entertain great doubts whether it will prove either the one or the other. If not, the officers under the Act will bear, as they now do, the odium as well of its deficiencies as of its oppressive enactments.

These officers have been accused, in high quarters, of neglect and apathy in the discharge of their duties with regard to certain sanitary regulations, and though they have disproved the facts alleged against them, and though, if these facts were admitted, they have clearly pointed out that the law does not enable them to interfere, or even to enter upon premises for the purpose of enquiry, yet the accusation remains recorded against them with the following special recommendation:—"should any amendment of the (Buildings) Act be in contemplation, this general neglect of duty on the part of the surveyors, and this apparent apathy of all concerned in the administration of the measure, with relation to the only provisions of it directly bearing on sanitary matters, ought not to be lost sight of." To any one at all acquainted with the Act, the accusation confutes itself, and I cannot help quoting with gratification one of the resolutions just passed by the Builders' Society, to show that it does not weigh much with them, viz:—"That the duties of the district surveyor could not be as well fulfilled by any but competent professional men, and that the interests of the public could not be protected efficiently by any arrangement which would throw these duties on a less educated class of men."

This is the gratuitous testimony of that class which has most concern in the operation of the Act. Those, on the other hand, who have had the charge of the new Bill, have thoroughly carried out the *former* recommendation; for not one of the officers serving under the present Act has been consulted in the preparation of this measure. The result of this unmerited distrust is, I submit, that we have in the new measure not a reform of what is faulty and oppressive (which is greatly needed), but many totally new regulations subverting even the very things most approved by those who are acquainted with the working of the Act. These are my reasons for seeking this opportunity of entering upon the subject which is amongst the most important to have properly settled, namely, the rules for determining the thickness of the walls of buildings.

The short story of the Bill and its changes on the subject before us, since its first appearance about six weeks ago, seems to me sufficient of itself to occasion some diffidence in the minds of those who do not profess to judge of its scientific and practical merits. It was printed at the end of April, read a second time, and referred to a select committee. Previously, however, to its coming before the committee in the middle of May, all the rules relating to the thickness of walls had been struck out,

and new ones *on totally different principles* were substituted, in order to meet the outcry against their being complex, and giving erroneous results. The district surveyors, however, and perhaps others, pointed out to the framers of the Bill, that besides the difficulties of working out such complicated rules, they were seriously defective in many points which they particularized. The consequence was, that before any discussion on them took place in committee, a third edition was printed, in which these defects were thought to be remedied by means of special rules intended to meet the objections. This not being the case in the minds of the objectors, at the request of one of the framers of the measure, I discussed the subject with him, and afterwards with him re-cast the schedule in a new form, to which I at first, though (it appears) in error, thought he agreed. This re-cast was put in by the district surveyors, and is now printed by order of the committee, as well as the framers' schedule, which has now assumed the form of a fourth edition.

It has, however, been put in by them on the express understanding, that they do not assent to the rules which still remain for determining the thickness of walls of public buildings, where any story is more than twenty feet in height. These rules merely remain because under the altered constitution of the Bill they were not able at once, in so short a time as has been allowed them, to propose a substitute. As they stand, the rules cannot work well.

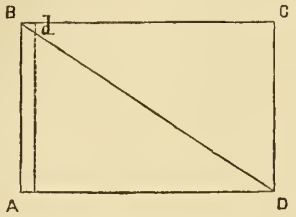
One important improvement however, has, I think, been introduced into this Bill, by allowing Buildings to be built in compartments separated by cross walls, the thickness of the walls being regulated by the size of the compartment, and not of the whole Building, as in the present Act. The advantages of this are, among other things, that it will conduce to economy of space and cost by allowing thinner external and party walls, and to sounder construction and greater stability by encouraging brick internal walls instead of wooden partitions; thereby also causing a great diminution in the risk and extent of fires, and in the end probably to the reduction of premiums of insurance. I may perhaps be allowed to say, that I first suggested this system to Lord Seymour, then first Commissioner of Works, in March, 1851, when I carefully pointed out all its advantages.

These cross walls are to be at least two-thirds of the thickness required for external and party walls, but not less than $8\frac{1}{2}$ inches thick; to have the openings limited to a third of the vertical area in each story, and to be carried up at least two-thirds the height of the building—I think four-fifths would be better.

We come now to the rules proposed by the framers of the Bill for determining the thickness of external and party walls. One professed object of the framers is to simplify the Act by dispensing with the system of *rating* buildings, which was introduced into the first Building Act passed in 1667, the year after the fire of London, and said to have been framed by Sir C. Wren. A diagram on the wall shews the four sorts (or rates) of buildings and the thickness of the walls in that Act. I must here assert, that there is a complete declension from the framers' original intention. In the first Bill, it is true, it was completely carried out, but it was so, by introducing a far more complex system; by losing sight of many matters which past experience had shewn to be proper and requisite; and by permitting many defects and anomalies in practice. These having been pointed out (and I will presently show some which remain after the last revision), a most complex system of rating actually, though not nominally, has been introduced into the new edition. Let me read some of the rules for dwelling houses, S. 4. We have here, besides the general rule, no less than seven special ones according to the seven different sorts (why not call them rates) of walls. Warehouses, and that class of buildings, have likewise another system of rates of walls. And more than this, while the present Act gives but one rate to each building, the Bill would give a separate rate to almost every *wall* of a building. This must then surely negative any advantage said to be gained in this respect, and moreover give the

comparative merit of simplicity to the present Act. I am not sure that I might not go one step further, and submit that this complex system of the Bill ought, in this respect alone, to prevent its adoption for ordinary buildings. But, it will probably be said by many, that if the result obtained is right, it will be worth this complex machinery, and into this result we will therefore enquire.

Now, the system proposed in the Bill purports to be founded upon the principles set forth by Rondelet, which he based upon, as he says, "an infinity of experiments, observations, and calculations." His first rule, which is that adopted in the new Bill, with a modification in the denominator, is as follows:—



Let A B C D be the elevation of the wall of a building, between return walls at A B and C D, without any tie or abutment except at its top and base. Draw the diagonal B D, and set off on it B *d* equal to a twelfth part of the height A B, and draw a line through *d* parallel to A B and the space between this line and A B is the required thickness of the wall. The height A B, be it observed, is from the floor to the tie of the roof, not to the top of any parapet or gable as in the Bill. The following formula gives the same result.—The thickness $=\frac{l \times h}{12 \times d,}$ (l, h, and d, being respectively, the length A D, height A B,) and diagonal B D. This, though only a rule of thumb, seems to be founded on some degree of reason; for it is evident that in walls of the same height, the longer a wall is between return walls, the thicker it ought to be within certain limits; nevertheless, the thickness ought not to increase so fast as its length, because the height must be the principal element in determining the thickness. This is attained by the rule where the length is much in excess of the height, inasmuch as, supposing the length to increase from A towards D, and onwards by equal increments, the corresponding increments of the ratio of the height and diagonal would be continuously diminishing. In the same case, the thickness would increase nearly in proportion to the increase of height. But the rule fails more and more as the height becomes more and more in excess of the length, till it gives absurd results, as in the walls of towers.

The formula of Rondelet is as I have said:—

$$\text{The thickness} = \frac{l \times h}{12 \times d}$$

That of the last edition of the bill is for public buildings,

$$\text{The thickness} = \frac{l \times h}{18 \times d}$$

Now my impression is, that the divisor 18 will make the walls too thin for safety when in one story, and that Rondelet's divisor 12 is better. It is, however, a subject which requires great consideration, and I hope some light may be thrown this evening on this point. I give a few examples of calculations on both formulæ, in the diagrams suspended, in which are three instances of the aisle walls of churches with galleries. In these, Rondelet's rule comes nearer than that of the schedule to the actual thickness; but I think that a mean between 12 and 18, will be found better than either for brick walls of public buildings in one height.

The formula ought, as I have shown, to be discontinued when the height is much in excess of the length; otherwise a wall, say 60 feet high and 20 feet long, would have its base no thicker than one 20 feet high and 60 feet long, and the Bill does so when the height exceeds twice the length, by requiring the thickness to be $\frac{1}{40}$th of the height. Yet I think this also gives too slight a wall, and requires the fraction to be increased.

For myself, I certainly think that for public buildings with a high story, a formula ought to be introduced for determining the thickness of the walls, instead of the undigested rule of the present Act, though it may not be applicable on every occasion, and then special calculations must be resorted to. At the same time I think a far more perfect formula may be obtained by varying the thickness with reference both to height and to the square root of the length, which is founded on the reasons I have before given, and would not require abandonment in certain cases, as Rondelet's and the framers' rules do. I venture to submit the following formula therefore for consideration, though it is but a rule of thumb.

$$\text{Thickness in inches} = \frac{2\,h}{5} + \sqrt{l} \quad (h \text{ and } l \text{ in feet.})$$

Many speak against any such rule as being complicated, but this would not be the case, because of course directly after the Act was passed, tables would be formed just as we now have with reference to bearings of timbers.

But where I venture entirely to differ from the framers of the Bill is in their not limiting this rule to *public buildings where there are lofty stories*, and then only to such *lofty stories themselves*. Rondelet himself, in giving this rule, limits it to *walls in one height without ties or abutments* given to it by intermediate floors or roof. In the case even of the clerestory wall of a basilica he modifies it by setting off on the diagonal, as at B d, $\frac{1}{12}$th of the height of the clerestory added to $\frac{1}{24}$th of that of the part below it; thus diminishing the thickness on account of the aisle roof.

But for buildings composed of many stories he says distinctly, "In ordinary houses where the height of the stories does not exceed 12 to 15 feet, in order to find the thickness of walls, whether internal or external, regard must be had *only to the width of the spaces which they divide, and to the number of stories which they have to sustain.*" It is not however necessary for me, I am glad to say, to go into the rules he gives for these buildings in stories, for this reason, that the framers of the Bill have themselves *unaccountably* forsaken these rules which Rondelet himself prescribes, and have adopted his first rule which I have explained, and which he most distinctly repudiates for ordinary buildings in stories.

The framers' schedule is consequently still full of serious defects and anomalies, notwithstanding that they have departed from their first principle, and have introduced so many special rules for the purpose of obviating (as before-mentioned) some particular inconsistencies in the application of their general rule.

I will point out two or three defects:—

1st. Small houses, now called fourth rates, if they have *four* stories, are to be allowed *two* stories of $8\frac{1}{2}$ in. walls, whereas if they have only *three* stories they are allowed only *one* story of the thinner or $8\frac{1}{2}$ in. walls. This is the reverse of equitable.

2ndly. In the larger description of houses, say there are two walls each 40 feet long between return or cross walls, and suppose one is 75 feet high, the other 85 feet high, the latter may have a greater height of the 13 in. or thinnest wall than the former.

3rdly. In any such buildings any of the uppermost stories, such as may be used as a gallery or

show-room, might have been of any height up to about 40 feet, and yet have had the walls only 13 in. thick.

I say, *might have been*, because a new edition of the framers' schedule has just been printed, and is now laid on the table of this Institute for the first time. This, I believe, has taken another amendment from the present Act, by introducing a rule for increasing the thickness of the walls of stories, when above a certain height, beyond the thickness otherwise required.

Now, under the rules of the present Act, I venture to say that not one such palpable defect or inconsistency can occur, but under the framers' schedule there are many more than I have specially mentioned, which I have not had time to put into shape.

There is one great anomaly, I admit, under the present Act, if the official referees, and with them about three of the district surveyors are correct in their view of the Act, which is, that the small buildings commonly built in the rear of larger ones, and communicating with them, should require thicker walls than the larger building, because by the addition of the smaller building the rate of the whole had been increased. This, however, would be completely remedied by the new system of cross walls.

The Bill then, as I have above shown, is inconsistent and erroneous in its practice, and at variance with its own authority, Rondelet, in adopting, in spite of him, his first rule for ordinary buildings in stories, and in forsaking his general principle, that in determining the thickness of the walls of such buildings "regard must be had only to the width of the spaces which they divide, and to the number of stories which they have to sustain." Clearly neither one element nor the other comes into the calculation. I do not say that Rondelet is perfectly right; but at all events he has named two principal elements.

But while the new Bill *does not* recognize these elements, the present Act *does* so, in the case of dwelling houses, by rating them according to area as well as by the height and by the number of stories. In the rating by area, the width of spaces between walls may be deemed to be sufficiently taken into account; for in—

4th rates, the extreme width is	$\sqrt{400}$—9 inches,	or about	19 ft.,	or in ordinary cases, say	15 ft.
3rd	„	„	$\sqrt{600}$—1 ft. 2 in.	„	23 ft.	„	17 ft.
2nd	„	„	$\sqrt{1000}$—1 ft. 2 in.	„	30 ft.	„	22 ft.
1st	„	„	$\sqrt{1400}$—1 ft. 6 in.	„	36 ft.	„	27 ft.

And to meet these progressive widths are these progressive rates, requiring a progressive increase in the thickness of the walls.

The number of stories also is taken into consideration by the system of determining the thicknesses by reckoning from the top of the wall downwards, instead of, as in the 14th Geo. III. from the base upwards.

I believe, therefore, that for buildings in stories the system (I do not say all the details) of the present Act is as perfect as possible, including in it of course the rules for increasing the thickness of walls of high stories and their sub-structure.

In the re-cast schedule it is therefore proposed to retain the rules of the present Act for the dwelling house class (with the exception of allowing in fourth rate houses only two instead of three stories of the party walls to be built of $8\frac{1}{2}$ thickness, as the latter has been found not to be sufficient for stability), also to retain them for warehouses and manufactories, with slight exceptions. It is further proposed—notwithstanding those general rules, that every story of a dwelling house shall have the thickness of its external and party walls at least $\frac{1}{15}$th of the height of the story, and in warehouses and manufactories $\frac{1}{12}$th of the height; and that any extra thickness may be disposed in piers $\frac{1}{3}$rd

the length of the wall, and that any sub-structure shall be increased in the thickness proportionably to the superstructure. Where public buildings are built in stories not exceeding twenty feet in height, it is intended that they shall follow the dwelling house class, where, however, public buildings have any story or stories exceeding the height of twenty feet, then to let them follow the rules of the framers' schedule which, however, I think might be improved by keeping the rule to a single story, and by decreasing the divisors 18 and 40 to numbers nearer to—say 15 and 30.

One other new introduction into this Bill, which I think quite right, and that it will be attended with perfect security, is the allowance of recesses in party walls as well as in external walls.

In conclusion, I wish to state that the remarks which I have ventured to offer have been made with the determination of adhering as far as possible to the Bill before us; because there are doubtless wise reasons for adopting the general scheme of the Bill. But with regard to public buildings, the District Surveyors have long ago urged the value of the superintendence as to their safety being delegated, as at present, to more than one architect. Make what rules you will, it will be found that to the large majority of public buildings—excepting those built in stories—they will be totally inapplicable, in one part proving very obstructive and oppressive, in another insufficient for safety. In the former case the architect must get relief by application, as now proposed, to the Superintending Architect, to whose single decision—perhaps of not equal consideration to his own opinion—he will have to bow. For this object a Board of Architects, as at present constituted, must be far preferable—at all events till the happy time shall come when public buildings shall in all cases require an architect, and an architect in all cases a diploma to show his qualification for his profession—when official supervision, as to safe construction, might be probably dispensed with altogether.

The Chairman, Mr. Tite, V.P., M.P., observed that the real matter for discussion was very simple. It had been a great inconvenience that the existing Act, and the Bills as previously printed were indefinite, but the copy of the Bill in its latest form, which he had that day obtained from the office of Woods and Forests had his unqualified approval. It contained a clause suggested by himself to the effect that the Institute might cause to be examined by such persons, and in such manner as they might think fit, all persons who might present themselves to be District Surveyors, and that the Institute should grant certificates of competency, without which no District Surveyor should be appointed. This was a point gained, and more might have been gained if the District Surveyors had acted with the Committee of the Institute. Those gentlemen, however, had acted independently, and had to a certain extent defeated the object of the Institute by interfering and suggesting something altogether different from that which the Committee proposed. Division among the members of a profession, not numerous in themselves, was much to be deprecated; and the sooner it was put an end to the better. With regard to the thickness of walls, he considered it was idle to occupy time in the discussion of formulæ and principles. As a practical architect, he was sure that the regulations laid down in the schedule would in the main break down; but this did not signify, as the bill contained two clauses which, with a little amplification, might have superseded the necessity for the schedules. One of these clauses provided that the Board of Works might alter the rules for the thickness of walls. Therefore if the formulæ suggested, either on one side or the other, did not work well, there was the power to change it, and that power would in fact be in the hands of the architect to be appointed by the Board of Works, who would see the necessity of exercising it. The other clause provided that in the case of "any building whatever except those mentioned in the last preceding

section," namely, buildings of iron and glass, the builder might either construct the same according to the rules of the Act, or he might represent to the Board of Works the inapplicability of the rules, submitting a plan and particulars, and then the building might be erected in any way which the architect appointed by the Board might direct. To the existing system of "rates" there were some objections, because mathematical rules must be limited, definite, and arbitrary, and they must lead at times to inconvenience; but in the main the schedules of the existing Act were understood and were satisfactory. With regard to the new schedule, he should only be disposed to modify it by making it more technical. There were some excellent points in the Bill, and not the least of them was that questions of difficulty would be handed over to the responsibility of one individual, so that they would know who to blame if he went wrong. With regard to the schedule, it should be remembered that walls were built according to the size of the bricks,—namely, 1 brick, 1½ brick, 2 bricks, &c., in thickness, whereas these thicknesses were expressed in the schedule in *inches*, which no bricklayer or ordinary individual would understand. The framers of the schedule had taken the size of the brick as *exactly* 8½ inches, whereas some were rather more, and even the fraction was not correctly carried out in their measurement of thickness. He would recommend the meeting to take the Bill for the good which was in it. The Legislature could not be expected to go into the abstract questions raised by Mr. Hesketh. The question was whether the meeting wished to retain the present system of rating by area and height, and on this point the Committee of the Institute and the District Surveyors should be unanimous before the Parliamentary Committee. They must either abide by the present system of rating, or take the new schedule for good or for evil, seeing that the Bill contained a remedy in case it did not work well.

Mr. C. Barry, Fellow, suggested that the present system of rating might be retained, together with the improvements introduced by the new Bill.

The Chairman said he had urged upon the Parliamentary Committee the propriety of adopting the new Bill with the *schedules* of the existing Act. That question was reserved by the Committee for consideration, and that was in fact the question for discussion, whether the Institute preferred a schedule which retained the old system of rating, or one which abolished it entirely. The question was limited to the schedule apart from the Bill itself.

Mr. C. Barry. The schedule of the existing Act had been long in use and was intelligible, and probably a majority would decide that it had been found to work sufficiently well, and not to need any important change. The system of rating was thoroughly understood by professional men and intelligent builders, and it would be much better than any complex system such as that now proposed.

Mr. Papworth, Fellow, inquired whether the Committee of the Institute had recommended the system of rating of the old Act or of the existing Act.

The Chairman.—They ended in recommending the system of the present Act, the schedules of which appeared to them, with the aid of the diagrams attached to them, to be perfectly intelligible.

Mr. Papworth then moved—"That the Committee of the Institute be requested to urge respectfully upon the Special Committee of the House of Commons on the Metropolitan Buildings Bill their opinion, that it is not desirable to change the principle of rating of the present Act, and the thickness of the walls consequent thereupon; and that in their judgement it is most desirable to retain the schedules of the existing Act relating to these subjects." He had observed many points in the new schedule upon which a difference of opinion might arise, whereas the existing schedule was clear; and if a man engaged to build a house of not less than a particular rate, there could not be any mistake about it.

Mr. C. Barry seconded the motion.

Mr. Jennings, Fellow, observed that there was little to complain of in the schedules of the existing Act; the only difficulty as to the thickness of walls being in the case of public buildings, when it was necessary to apply to the Official Referees for a modification. The schedules had worked well, but the other machinery of the Act was defective, and prevented its being carried out. It was now proposed that the Government Official should have power to alter the rules of the Act as he pleased. The propriety of such an arrangement was rather a question for the public than for the profession; but he thought architects would object to be liable to the crotchets of any one individual. When he first saw the present Bill, it appeared to him to affect very much the liberty of the subject; and he regretted that it had not, like previous Bills, been sent to the District Surveyors and the profession generally, in order that they might have an opportunity of stating their objections to it. As far as his own experience went, he thought the existing schedule worked well. With regard to the thickness of walls being defined in inches, he differed with the Chairman. The present size of bricks was not, he thought, the most convenient; and probably perforated bricks of larger size might be used, as they would not be heavier than solid bricks of the present size. The size of bricks not being now fixed by Act of Parliament, alterations might be expected which would render the definition of thickness by the number of inches necessary.

The Chairman said it was necessary to provide for bonding; and although there might be bond with a ten-inch brick, it was necessary to state that the wall should be one-and-a-half, or two bricks thick. The schedule ought to be so worded as to insure the erection of a wall with bricks that would bond together and make sound work.

Mr. Jennings concurred in the importance of the point referred to, but improvements in the manufacture of hollow bricks, &c. should not be impeded.

Mr. Penrose, V. P., said that having acted somewhat as junior architectural counsel, under well-skilled seniors, in the preparation of the Bill, he could assure the Institute that there had been no intention to avoid bringing the measure earlier before them. The delay had arisen entirely from accidental circumstances. The District Surveyors had been very much consulted, nearly fifty reports, which had been received from them some months ago, having been carefully considered. Lord Seymour's Bill, which had been much used in the preparation of the present, was also based very much upon the evidence of the District Surveyors. The question really was, Rating or no rating? And on this point, the reports of the District Surveyors in many cases raised a doubt whether the existing system was a good one. It had not appeared right to the framers of the measure to put *all* buildings, as it were, into five boxes of fixed sizes; but rather that they should consider walls in themselves, and in reference to the work which they had to do. Rondelet, as the great authority on this point, was consulted, and both of his systems were worked out with great care, hundreds of examples being tried. Looking at the proposed schedule in its present form (and disregarding the accident which led to the printing of one system which it was necessary to recall), it was believed that the rules laid down would give the proper thickness of wall in almost every instance; and where it did not, there was a remedy by application to the proper authority. The existing rules for rating, it was true, might be understood after some consideration; but in many cases great inconvenience was felt in carrying them out. Perhaps a design for a building might exceed ten squares by a few feet only; and then, to avoid going to the expense of a first-rate structure, great difficulty and trouble were incurred in order to get it into the second-rate box. In the country, beyond the limits of the Building Act, walls were considered by themselves, and it would be thought a hardship to regulate their thickness by the area of the building. Mr. Penrose referred to the schedule and the table showing the thickness of walls of different heights, in order to show the

facility with which it might be applied. He also referred to diagrams to show the working of the new system, the general effect of which, he stated, would be to modify the somewhat too great safety of the present walls, and thereby to give an advantage to the builder and to the public, at the same time insuring in all cases an adequate degree of strength. He knew it was the opinion of many besides himself that the system of rating was inconvenient, and that a simple rule for determining the thickness of walls by themselves was preferable. The general rule proposed, and which would apply in nine cases out of ten, was that when the length of a wall did not exceed half its height, then its thickness should be $\frac{1}{50}$th of its height; and where this was the case, the simplicity of the rule would supersede any reference to the tables: and even in other cases such reference would be very easy, as the tables were short, and might be carried on a slip of paper in a pocket-book.

Mr. JENNINGS inquired if the Bill provided for the intended height of a wall being ascertained before its erection.

Mr. PENROSE said it did. By the tone of the remarks which had been made, he felt sure that they had met together to help the measure where it was good, and to improve it by criticism where it might be defective.

Mr. PAPWORTH raised an objection to the working of the table in the schedule in a suppositious case, which—

Mr. PENROSE regarded as exceptional, and one which was very unlikely to occur; observing that it was impossible to legislate for exceptional cases, and referring again to the power of alteration vested in the architect to the Board of Works.

Mr. JENNINGS inquired if the new Bill would allow a wall to be filled with flues as at present, thereby reducing its thickness to a few inches. He also made an inquiry respecting corbelling over.

Mr. PENROSE said that the recesses allowed in the Bill would leave the piers more solid, and the evil referred to was therefore not likely to occur. Corbelling would be limited to the thickness of the wall corbelled.

Mr. G. R. BURNELL, C. E., considered the power of altering the rules of the Act objectionable, as the principle of all law was its certainty. It was, in fact, absurd in logic to make enactments, and to give the power to vary them; especially as that power would be vested in one individual, no express provision being made for his capacity or professional position, although, of course, the Government would not venture to appoint a person who was not duly qualified. The proposed schedule, like all former schedules, was defective, as it did not embrace buildings having roofs of large span at considerable heights, such as railway stations.

Mr. PENROSE said all railway buildings were excepted.

Mr. BURNELL,—Why should they be excepted?

The CHAIRMAN observed that the dispensing power, or the power of the keys, to loose or bind the rules of the Act, had been definitively settled by the Committee, and it was therefore useless to discuss it; and with regard to railway buildings, the Chief Commissioner of Works well knew that if he attempted to include them in the Act, he would raise a storm which would be irresistible. The discussion had better be confined to the question of rating or no rating.

Mr. BURNELL said that as far as dwelling houses were concerned, he did not see any necessity for altering the old schedules; the difficulty only arose with reference to public buildings. Mr. Burnell then referred to the Strasburg Railway Station at Paris, 500 feet × 100 feet, and 45 feet high) the walls of which were only 1 ft. 10 in. thick, whereas, according to the formula of Rondelet, and the proposed schedule, they ought to have been 3 ft. 7½ in. if without buttresses, or 2 ft. 5 in.

with buttresses. Mr. Burnell also cited a polygonal engine shed at Tours, of which the dimensions were as follows :—radius of the circle, 66 ft. 6 in.—span of roof bearing on the external walls and on internal columns, 33 ft. 3 in.—sides of polygon 25 ft. 7 in.—the thickness of the wall being 2 feet. This thickness coincided with the formula of the Rondelet, but according to the schedule in the first edition of the Bill under discussion, the thickness need not have been more than 10 inches. Mr. Burnell stated that in his opinion Rondelet had not been sufficiently studied on this point. He concluded his remarks by handing in a statement of the thicknesses of walls used in Paris, in accordance with law and custom, translated from Claudel's "formulæ and aide memoire for architects," and given in English measures.

The CHAIRMAN read the statement handed in, observing that it would not apply to English practice, where the materials used were different.

Mr. C. BARRY urged in favor of the existing system of rating the facility with which the rate could be determined by the area set out; whereas the height of a wall (the new element proposed) could not be ascertained till its completion. The power of deviating from the rules of the Act might, it appeared, be obtained by applying to the Board of Works, but experience proved that owing to the multiplicity of business before them, an immediate answer to such applications could not be expected, and that, on the contrary, the answer might be delayed for six or even twelve months. The interests of the parties would consequently suffer most cruelly, and practically they would go on in defiance of the law, as they did at present. The existing rules for rating applied exceedingly well to all ordinary buildings, and when a building was of extraordinary size and importance, a far better guarantee than the rules of any Act of Parliament would be afforded by the reputation of the architect or engineer employed. Competent men were always employed in such buildings, and their reputation was involved in the stability of the structure. The Act should be so framed as to control the speculative builder, who merely sought to make money and build cheaply, and who had no reputation to lose.

Mr. ALD. CUBITT, M.P., said that when he was asked by the Chief Commissioner of Works to act on the Committee on the Bill, he had felt it his duty to consent. He, in the first instance, carefully read the Bill, and was much struck with its merit as introducing a system of extreme simplicity with regard to the thickness of walls; and he was still of opinion that it was more rational to take the height of each individual wall, and to consider its requirements in reference to its height, rather than with reference to the area of the building. He was the more convinced of that by considering the anomalies of the existing law. If a building contained four squares, it was a fourth-rate building, and if it contained more, the walls must be of a greater thickness. But as a building of four squares would not accommodate two families, an "addition" was made to it, the walls of which were allowed to be of the same thickness as those of the building itself. Therefore the law sanctioned that as an evasion which the proposed new system would permit. Moreover, the evasion gave more trouble to the District Surveyor, and the house costs more by reason of the delay for the "addition," and must be let at a higher rent. There was no necessity for adhering to the old law, and although the system of rating might afford some facilities in letting land for building a particular rate of houses, there would be no difficulty on the new system, but what the Surveyor and Solicitor of any estate could readily overcome. There was nothing indeed to recommend the existing system, except that architects were accustomed to it, and had been brought up in it. He had been a builder 40 years, and ought to have obtained a great deal of experience; and if he were still a builder, he was satisfied that by inspecting the drawings, and ascertaining the length and height of a wall, he should at once be able to determine its proper thickness under the proposed schedule; and the District Surveyors would in like manner find no difficulty in it whatever. He had

often had to deplore the necessity of making a wall of an unnecessary thickness, because the building happened to be of a certain rate. The present was an age of reform, in which it would not do to uphold a system because it was old and well understood. On the contrary, all reformers would join in any well digested scheme by which the construction of houses could be made better and cheaper, and by which all unnecessary machinery could be got rid of. They were now 200 years in advance of Sir Christopher Wren, and it was strange indeed if they could not improve upon a system which was probably the best which could then be suggested. He was gratified by the honor of being invited to attend the present meeting, and felt sure that the Institute would look rather to the interests of the public than to those of a class.

Mr. T. Piper, Visitor, expressed his opinion, that the schedule to the Bill, as that day printed, would be acceptable to builders. The rule of determining the thickness of a wall by its other dimensions must commend itself to all as a simple and practical rule, and far preferable to that of the area which it might enclose. It would be very easy to fix the limit of height before a building was commenced. As an illustration of the difficulty to be expected in applying for any departure from the Act, Mr. Piper stated, that on one occasion he had received permission to erect a house, just four weeks after it was finished and occupied; but even this difficulty might be met if the time was defined. (The Chairman said, that point had been absolutely settled by the Committee.) Mr. Piper added, that as a builder, he had been quite alarmed by the elaborate mathematical formulæ which had been displayed in the course of the discussion. They only wanted a simple application of plain rules, such as they could all understand. The result of experience shewed, that out of 100 buildings in London, 52 were of the fourth rate, 27 of the third rate, 14 of the second, and only 7 of the first rate; therefore, so much profound science was not generally required. He preferred the definition of the thickness of walls by inches rather than the number of bricks; for with all the prejudice of education in favor of the existing size of bricks, he was not prepared to say there might not be changes and improvements in bricks hereafter. He regretted that the Bill had not been made sufficiently simple in all its provisions, to apply not only to the metropolis, but to all large towns. The schedule, in its amended form, would practically have the effect of permitting very much such houses as they were accustomed to build, whilst it would proceed upon a principle which all could understand, namely, that of making a wall do its duty as a wall, without reference to any other part of the house.

(Some discussion ensued between Mr. Jennings, Mr. Hesketh, and Mr. Alderman Cubitt, in reference to the case put by the latter as to an "addition" to a fourth-rate building).

Mr. Hesketh said, that with regard to first and second class buildings, he approved of the existing system, with one or two very slight modifications. The present Act was indeed founded upon Rondelet, and carried out his views better than the new Bill. As the Institute of British Architects, and aided by the advice of the most eminent builders, they ought now to determine which was the best system.

The Chairman observed, that the Bill was expressly intended for the metropolis, and therefore the argument of Mr. Penrose, as to what would be done in erecting a house in the country, would not apply to the present case. With regard to the proposed schedule, the inconvenience which would arise from its concluding in one case at thirty feet, would be as great as the inconvenience pointed out by Mr. Penrose in the system of *rates*. The great object was to protect the interests of the public as against the interests of speculative builders. Reform should be carried out, but they must not introduce confusion. The present system was well understood, and was working well; and why, therefore, should it be changed? The technical phraseology of the schedules ["Let a right angled triangle," &c. &c.

&c.], was enough to confound a plain man before he got half way through them. They were not dealing with cases where architects were employed;—for even in the highest possible quarters, it was not now the fashion to employ scientific men. Mr. Cubitt and Mr. Piper had shewn the anomalies of the present Act, and he trusted the new Bill, as distinct from the schedules, would remove the unworkable machinery and simplify the law. Under the existing system, he had found it necessary to persevere with works which he knew to be morally and scientifically right, in defiance of the district surveyors and official referees. This state of things, however, ought to be reformed, but not by introducing confusion. If walls were only to be regarded with reference to their dimensions, people would forget that their real object was to enclose areas, and to carry floors and roofs; and for these reasons, he considered the system of rating to be a natnral and proper rule. He had opposed, and should continue to oppose the change of the law as to walls. The Chairmau then called attention to the terms of Mr. Papworth's motion.

Mr. Hesketh proposed to move as an amendment, "That public buildings should be excepted." He thought that public buildings in stories exceeding twenty feet in height, required some special scientific rules for determining the thickness of walls.

After some conversation, the proposed amendment was incorporated with the original motion as follows:—"That the Committee of the Institute be requested to urge respectfully upon the special Committee of the House of Commons on the Metropolitan Buildings Bill, their opinion—that it is not desirable to change the principle of rating of the present Act, and the thickness of the walls consequent thereupon; and that in their judgment it is most desirable to retain the schedules of the existing Act relating to these subjects; except as to the Public Building Class, to which the new schedule may with propriety apply."

The motion being put to the vote of the Fellows present, was carried, Mr. Penrose alone voting against it.

A vote of thanks to Mr. Hesketh, was then put and carried unanimously.

Mr. Hesketh stated, that the district surveyors had not at all intended to act in opposition to the architects in reference to this Bill, but being so much concerned in the practical and working part of the measure, they had thought it better to withdraw from the Committee of the Institute, leaving the latter to represent the more scientific view of the subject.

The meeting then adjourned.

PRACTICAL OBSERVATIONS ON PILE DRIVING.

By G. R. Burnell, C.E.

Read at the Ordinary General Meeting of the Royal Institute of British Architects, June 18, 1855.

Piled foundations are most advantageously employed when the solid ground, over which it is proposed to erect any important edifice, is situated at so great a depth from the surface, that the removal of the softer and sometimes unequally compressible intermediate strata would be attended with excessive delay, difficulty, or expense; or when there is any probability that either the intermediate materials, or the substratum on which they rest, may be displaced by land springs forcing their way under the foundations. As these conditions occur most frequently in hydraulic engineering, and I have had some practical experience in works of this description, it may afford a subject of interest if I lay before you some observations which I have been led to make during the progress of the various operations which have come under my notice; dwelling principally upon facts, and avoiding as much as possible any purely theoretical, or disputed questions connected with the subject.

Piles are usually formed of round or squared timber, and are driven into the ground in a vertical direction, or in one corresponding with, and parallel to, the resultant of the forces they are intended to resist. Of late years, however, both cast and wrought iron have been used instead of wood, in some situations with remarkable success. But in salt or brackish water, a chemical action upon the metals takes place, which renders their application very questionable, even if it should not be considered to justify their total exclusion in positions of this description, in which engineers are compelled to use wood, notwithstanding the danger to which it is exposed from the attacks of the boring worms.

The kinds of timber most frequently used in England for piles, are beech, elm, Scotch or English larch, Baltic fir, the American rock elm, live oak, the green heart, or the sabacu, from Guiana. The two last named are said to resist the attacks of the borers, but we have hardly sufficient practical experience in this respect to justify implicit belief in their superior value. It is, therefore, very desirable that authentic observations should be made upon their durability in waters where the above-named destructive worms occasion the greatest injury. On the continent, beech timber is principally used for piling, and a prejudice appears to exist against the family of the firs; round timber is also preferred for detached piles to timber which has been tool dressed; indeed, Perronet says expressly, that "such piles ought not to be squared;" but, he adds, "they must be straight in the grain, and without projecting knots." In England, the choice of the particular description of wood appears to be regulated by the nature of the ground into which the piles are to be driven; or by considerations connected with the local markets. Amongst workmen, piles of American wood are generally known by the name of "*hard wood piles*;" and those of European are called "*soft wood piles*."

The preference of any particular description of wood for pile driving, it appears to me, should depend more upon its durability, and immunity from attack by either organic, or inorganic causes, than upon its original cost. Beech timber decays very rapidly when exposed to alternations of dryness and humidity; elm resists such exposure more satisfactorily; fir, when free from sap, lasts longer still under such circumstances; but, of course, all woods decay with greater or less rapidity in positions where they are exposed to these alternations, and the only methods which appear to have successfully solved the problem of increasing their durability, are those of Kyanizing, or of creosoting. It has been stated, that the injection of the ingredients employed in the application of both these methods, renders the wood sufficiently distasteful to the boring worms, to ensure immunity from their

attacks. If this were true, the contingent advantage would, in marine or hydraulic architecture, be equivalent to that gained by the increased durablility of the wood; for the ravages of the borers are sometimes carried on with a rapidity, and to an extent, hardly credible. Little, however, appears to be positively known of the real habits of these destructive animals; but I am disposed to believe that they are most destructive upon limestone, marly, or clayey shores, and least so upon granitic shores. But if the wood employed on a granitic shore should contain any germs of these animals, they would infallibly develope themselves even there. In several cases, I have noticed that the borers do not touch the timbers driven near the outfalls of sewers, although they may be extremely destructive in all other parts of the same port: it would appear that the composition of the waters discharged from the sewers is fatal to them. The whole of this subject, it may be asserted, requires far more elaborate investigation than it has hitherto received from engineers, or architects.

According to their position in a foundation, piles are distinguished by the following names. 1. *Guage piles*, driven to define the limits of the ground to be enclosed, or to act as guides in driving the other piles. 2. *Close piles*, driven between the guage piles, to form a continuous enclosure of wood work. 3. When the close piles, instead of being of the same scantling as the guage piles are only of half timber, they are generally known by the name of *sheet piles*. The several descriptions are connected together by *wales* or horizontal ties; by cross braces; and in some cases by a platform, which is either entirely close, or formed as an open grating. The entry of the piles into the ground is facilitated by their being cut to a sharp pyramidal end, generally shod with iron, either cast or wrought: in sheet piling, however, the various pieces of wood have often a sharp edge, parallel to the face of the enclosure. Wrought iron hoops are generally used to prevent the heads from splitting in driving, or from becoming too much compressed. In some cases, piles are driven with the broadest end downwards, as for example, in foundations executed upon extraordinary depths of compressible mud; and Perronet appears to consider that there is some advantage in adopting this system when the middle of the height of the piles is situated at nearly the mean level of the water, a condition which sometimes occurs in the erection of large timber bridges. From some experiments made at L'Orient, recorded in Sganzin's Cours de Construction, it appears that piles so driven offer a resistance equal to about $45\frac{1}{2}$ lbs. per foot superficial of their frictional surface, which is barely a fifth of the resistance they would offer, if driven to a solid stratum. It is important to drive the piles, if this mode of placing them with the broad end downwards be adopted, by beginning with the outer rows, and working inwards towards the centre of the mass.

When piles are used in solid ground, and are designed to resist a vertical pressure, they are driven by means of engines until what is called a "*refusal*" is attained; that is to say, until they only descend a certain depth under an impulse, which is made to vary with the nature of the superstructure, the number of the piles employed, or the machinery used for driving: but when the piles are intended to resist a transverse strain, or any tendency of the foundations to lateral displacement, they must be driven until they attain a solid substratum, without reference to the resistance they may meet with in their descent. It is considered by some engineers, that the ground around the piles becomes so compressed in the former case that an adequate resistance in the foundations is secured, even when the piles are not driven to the more solid strata. In the latter case, the piles become fixed in the materials through which they are driven, and can only move by being displaced horizontally, or by being broken off on the line of thrust.

Although the earth in which piles are driven contributes to their power of resistance to an insistant load, it is not customary to take it into account; and the number, as well as the distance apart, of the piles is calculated as though they had to support the load without any assistance. In other

words, the weight which is brought upon each pile is calculated upon the supposition that it should be able to support such a weight in the air, without crushing. Under these circumstances, it is evidently necessary to diminish the weight upon any definite portion of the support in proportion as the height of the support itself is increased. Rondelet gives some tables of the weights which may be brought with safety upon the various descriptions of wood used for piles, according to their length; but it may suffice at present to observe, that when the length of the pile, supposed to be of oak, does not exceed sixteen times its diameter, it may be loaded permanently with a weight of from 430 to 500 lbs. per inch superficial of the sectional area, and the extreme refusal must be such as to ensure stability under such a load. There are few cases when the load above-named may not be slightly exceeded; at any rate, it must be considered to be fairly within the limits of stability, although far in excess of the load usually applied.

The rules generally adopted for fixing the "refusal," appear to be empirical, and to require more elaborate investigation than they have hitherto received. It is customary on the continent to fix it upon the following principles. If each pile be intended to bear a weight of twenty-five tons, it is not considered to have attained its proper refusal until it will not descend more than two-fifths of an inch with a series of thirty blows from a ringing engine, with a monkey of 12 cwt. falling four feet; or with a series of ten blows from a common pile engine, with a monkey of the same weight falling twelve feet. If the weight to be brought upon each pile should be $12\frac{1}{2}$ tons, the refusal is altered to four-fifths of an inch; and if it be only 5 tons, it is altered to two inches. But it must be evident, that the vibrations excited in the piles themselves, or in the ground, must differ so essentially under the conditions of the ringing engine with the small fall, from those which hold with the piling engine with the great fall; and the effects of the action and reaction developed under these respective circumstances must be so dissimilar, that no simple geometrical ratio can exist between the efforts exerted in the respective cases. At the bridge of Neuilly, where each pile supports a total weight of fifty-two tons, Perronet adopted the refusal of one-fifth of an inch for each series of twenty-five blows, with a fall of about four feet eight inches.

The engines generally employed for the purpose of pile driving are the ringing engine, the pile driver, and Nasmyth's hammer. The first consists of a frame in which a monkey, or rammer, is raised vertically above the pile by means of a cord passing over a large wheel, and worked by a number of men standing around. As all intermediate machinery is avoided, the blows struck by this engine follow one another with tolerable rapidity, and may easily be carried to twenty or thirty per minute; but the weight raised is necessarily limited by the unfavourable mode in which the power is applied, and the fall is equally confined within a small range. In the ordinary pile engine, the monkey is raised to any desired height by means of a crab; so that the weight of the monkey, and the height of the fall, may be made to vary within very considerable limits; but the number of blows given within a definite period becomes diminished in the same proportion that the power of the engine increases. Of late years, the Americans, and many of our contractors after their example, have applied steam power for working machinery of this description with considerable success. Nasmyth's hammer is, however, the most decidedly marked modification of pile driving machines lately introduced, and when applied under the proper conditions, it appears likely to render great service. Dr. Potts' system, and the modifications it has lately received, appear to be more adapted to secure the descent of what may perhaps be correctly described as small caissons, than of piles, as the word is usually understood. Attention is therefore called more exclusively to Nasmyth's hammer, as presenting the greatest advantages in certain situations.

It consists of a cylinder, in which a piston bearing a rod connected directly with the monkey, or

striking mass, is made to move in one vertical direction by means of high pressure steam, which escapes directly the piston reaches the head of the stroke, and allows the monkey to fall by the mere effect of gravity. The weight of the monkey need only be limited by the capacity of the cylinder, or the elasticity of the steam; and accordingly in practice it varies from 32 to 45 cwt. The height of the fall is, however, limited by the stroke of the piston, and rarely exceeds 2 feet 6 inches. At the same time, it is to be observed, that the number of blows is greatly increased beyond that which can be given by any hand gear; and instead of being from thirty-five to forty per hour, as in the case of the ordinary pile engine, it becomes from fifty to sixty per minute. The effect of each separate blow under these circumstances is naturally less with the Nasmyth's hammer than with the old engine; but the rapidity with which the blows succeed one another must considerably modify the descent of the piles, particulary in ground able to transmit undulations separated by long intervals. The whole question of the influence of the elasticity of the ground upon the rate and manner of descent is, however, still involved in too great uncertainty to admit of any definite conclusions on the subject; and indeed, it is found to complicate not only the theoretical reasoning upon, but also the practical operations connected with pile driving, to a very serious extent.

For instance, it has been frequently observed that after a pile has received a certain number of blows from an ordinary pile engine, it will "refuse," or cease to drive. But if it be then allowed to rest, and after a definite period the driving be recommenced, the pile will descend rapidly under blows of far less power than those which were previously unable to move it. This phenomenon has been attributed by some authors to the increase of the reaction of the ground developed by an exaggerated "vis viva;" by others, to the fact that the pile itself, and the ground round it, assume a state of vibration, which, for the time, disperses the effort exercised on the head of the pile. Nearly all the investigations which have been made with respect to the transmission of movement in elastic media, have been made upon the perfectly elastic gases; and they hardly bear upon the conditions likely to prevail in the denser, less homogeneous, and comparatively speaking non-elastic, materials into which piles are usually driven. But it appears at least more probable that the vibratory undulations produced by heavy blows succeeding one another at distinctly perceptible intervals, should, on their reflux, coincide and interfere with the transmission of a succeeding blow, than that the lighter blows following one another almost instantaneously should give rise to undulations of a character to check the descent of the pile. Indeed, in the latter case it is possible that the undulations—especially if they be reflected—would so far interfere with one another as to procure a comparative stillness of the ground.

The "refusal" to be adopted when Nasmyth's hammer is employed, may easily be calculated from those before given for ringing or for pile engines—assuming that the forces bear to one another a simple geometrical ratio. If a hammer of 34 cwt. be used with a fall of 2 ft. 6 in. a succession of seventeen blows would produce an effect presumed to be equal to that of thirty blows from a ringing engine of 12 cwt. with a 4-feet fall; or ten blows from a pile engine of 12 cwt. and a fall of 12 feet.

In the majority of constructions there is little difficulty in attaining these conditions; nor does the use of the Nasmyth's hammer ordinarily produce effects upon the descent of the piles themselves different from those which are to be observed when ordinary machines are employed; and in such cases, if a sufficient number of piles are to be driven to cover the outlay necessary to set the machinery to work, the economical results it produces are superior to those obtained by the use of any other engines I have had the opportunity of examining. The great rapidity, however, with which the blows succeed one another causes a much more considerable waste of timber in the pile heads than in using the old engines. If the wood happens to be soft, it is found, indeed, that the head

becomes spongy in a short time, and incapable of transmitting the impact. If, on the contrary, it is hard, the piles often take fire. Moreover, if the wood should be (to use a workman's phrase) shaky, and the ground hard, any vertical fissures become rapidly increased by driving—in all probability on account of some inequality in the transmission of the undulatory movement communicated by the blows through the different fibres, whose conditions of elasticity are often visibly dissimilar. The softer woods are most exposed to this disadvantage.

It appears to me that Nasmyth's hammer is less likely to develope this tendency to vertical fissure than the old pile engine; because the effective power of each particular blow is less than when the monkey is made to fall through a great height. In moderately resisting ground therefore, there appears, on this score also, to be an advantage in its use. But it is important to observe that it is precisely in such situations that the pile is likely to become deflected from its course; and if this effect be produced to such an extent as to cause the blow to strike the head in a direction inclined to the axis of the pile, the latter is exposed to be broken, or at least strained, to a serious extent, whatever be the system of driving employed. It is in very hard ground, and when the hard woods are used, that the piles are most likely to become ignited under Nasmyth's hammer.

These theoretical observations were confirmed by some circumstances noticed by myself during the execution of the works for the repairs of the Blackwall entrance of the West India Docks, in which I also had an opportunity of learning practically the conditions most unfavourable to the use of the steam pile hammer. In this instance the side wall of the river entrance to the Blackwall Basin was carried into the channel by a lateral movement of the ground, apparently produced by some copious land spring, or by the escape of the water retained in some of the inner basins at low tides. The old wall was carried bodily forward for a length of about 120 feet, in a kind of irregular curve, whose maximum versed sine was about ten feet: it sank about nine feet below its original level, and forced up the bed of the navigable channel nearly three feet. Mr. Rendel, who was consulted by the Directors of the Company, decided upon replacing the old wall by a timber staging. This was intended to be close planked at the back, on the land side, in order to retain the earthwork of the pier heads; to have a paved stone floor in the intermediate portion, between the close planking above mentioned, and a corresponding parallel row of close piles driven towards the water-way. It was proposed, also, that the whole of the piles to be driven on the inside of the old wall should be placed before the old works were removed—excepting, of course, in the positions where they interfered with the piles. The masonry and the earthwork, both in the channel and in the situation of the new stone floor, beneath the staging for the pier head, were to be removed after the completion of the latter.

The effect of retaining the ruins, in combination with the compression of the subsoil which had already been produced by the weight it had supported for so many years, was to create a degree of resistance to the entrance of the piles totally unprecedented. The ground itself consists in parts of a bed of rounded flints, agglutinated by fine white sand, occasionally containing veins of the hydrous oxide of iron. Apparently it is of the same nature as the Gun Fleet shoal in the bed of the Thames; and geologically it is analogous to the member of the basement beds of the London clay which occurs upon the surface near Bromley in Kent. When this bed is not confined laterally, it does not offer any very extraordinary difficulties to the descent of piles, or to the operations of boring—although evidently, in consequence of its composition, it must exercise great friction, both upon the boring tools and the piles driven through it; and the resistance so occasioned would naturally be seriously felt when it became necessary to insert close, or sheet piling. But, in this particular case, it appears that the old wall acted to prevent the gravel from spreading; and consequently the new materials, the piles, could only be introduced by displacing and compressing the materials into which they were forced. It followed that the labour, difficulty, and cost of the formation of the stage were

increased to such an extent as to entail a very heavy pecuniary sacrifice; and, indeed, in the case of some trial borings, to induce the contractor entirely to renounce the attempt to traverse the bed of gravel.

Under normal circumstances the cost of driving piles, properly shod and hooped, by Nasmyth's hammer, would have been about 2s. per foot forward in ground of this description, and upon an average of guage and sheeting piles, the rate of progress would be about five feet per hour. The cost of driving by hand gear would have been about the same; because the magnitude of the work in question was not such as to render the cost of the temporary staging required for the hammer an unimportant element in the relative value of the work effected by it. But, in consequence of the induration of the ground, from the causes before mentioned, the rate of descent was so materially altered that in the space of $1\frac{3}{4}$ hours no less than 5,880 blows were struck upon a pile head in the presence of the author, without advancing it more than three inches. Naturally, under such circumstances, the pile heads were rapidly "knocked up;" and frequently, when fir timber was used, as many as six or seven heads were required, thus entailing a loss of from four to five feet lineal of the baulk. When rock elm was used this source of expense was diminished; for it was found that the heads would in this case last three times as long as those of fir piles. But the nature of the timber did not otherwise affect the rate of descent, which varied from one foot to three inches per hour, and frequently cost as much as forty-two shillings per foot lineal, merely for the labour and working of the engine—leaving entirely out of account the expense of re-heading the piles, or any charges for superintendence, rent, rates, or taxes.

Excessive as this cost of the work was in itself, it was, however, still further increased by many of the piles being broken during their descent, in consequence of the shoes working off, and also of the development of longitudinal fissures. In some cases, where these fissures ran at a slight angle across the pile, the latter became so shattered, and the fissures opened to such an extent, as to render it necessary to cut off, or even to draw the piles, after considerable progress had been made in driving them. Both these sources of expense were of irregular occurrence, and it was almost impossible to guard against them; for neither the inequality in the resistance of the ground could be foreseen, nor do the longitudinal fissures always show on the sides or the ends of timber baulks in their original state before driving. The piles drawn on account of the loss of shoes were two; those which were drawn or cut off, on account of defects in the timber, were about ten in number: and it may be added that towards the end of the work it became necessary to use rock elm constantly instead of Baltic fir, from the increased resistance to the descent.

That this increased resistance was to be attributed to the compression of the ground, was proved by the following facts: In order to carry the stage close up to the old wall as it then stood, it was necessary to remove the ruins of the portion immediately upon its intended position. The first piles which were then driven descended with such ease, that in some instances 26 feet descent was obtained per hour, and the slowest rate was 1 foot 3 inches per hour in the case of the piles immediately behind the old wall. The guage piles, even in that portion of the works where the wall had not been removed, descended at the rate of 5 feet per hour. But the filling-in piles of the close sheeting became more and more difficult to drive as the work advanced; until at length the closers could not be driven more than 2 or 3 inches per hour, the engine working incessantly at the rate of about 60 blows per minute.

At the Great Grimsby Docks these difficulties did not occur. The works were, in this case, executed upon the alluvial mud at the mouth of the Humber, which lies (with a variable thickness) upon a stratum of hard clay. In consequence of the inequality of thickness in the upper stratum the piles varied considerably in length; being occasionally 70 or 50 feet long, whilst the average length

was 30 feet, of which the last four were in the harder clay. Sometimes the piles would traverse the first 26 feet in an hour, and the remaining 4 feet in half an hour; at others, and especially when many piles had already been driven near the position of the one observed, the resistance was greater. But there were few instances in which a less number than from 30 to 50 piles were driven per day by a single engine. To perform a similar amount of work with the ordinary pile engines would have required at least from 10 to 12 machines, with their respective gangs of workmen; so that it would appear that, under favourable conditions, the economical results of Nasmyth's hammer are such as to ensure its adoption. The cost of working the engine employed at the West India Docks, and at Great Grimsby, was about 10s. 6d. per hour, including wages of driver, stoker, carpenter to attend to the pile, labourers, and incidental expences; whilst the cost of each of the ordinary piling engines would not be less than £1. 0s. 6d. per day, without any allowance for interest on capital, depreciation, repairs, &c.

The practical conclusions which I am disposed to draw from my experience in the use of the various descriptions of engines for the purpose of driving ordinary piles, may be stated briefly as follows:—

1st. Ringing engines are adapted to driving short piles through ground of a moderate degree of hardness, but the immense number of men they require must exclude their use when the works are extensive, and many piles are to be driven.

2nd. Ordinary pile engines, or those in which monkeys of about from 12 to 16 cwt. with falls between 12 and 26 feet are used, are the most efficient and economical when the number of piles to be driven is small, or when the ground is remarkably hard.

3rd. When, however, the number of piles is great, and the ground of an ordinary degree of hardness, Nasmyth's hammer is the most economical mode of executing works of this description.

It must, then, it appears to me, be the duty of the contractor to carefully estimate the relative proportion the first outlay will bear to the whole expense of the works, and to ascertain the precise nature of the ground (both in its original and its contingent states) before he decides upon the machinery he will adopt for pile-driving in any particular case. The engineer or architect probably ought also to take these considerations into account, before he fixes the time for completing the works.

In certain positions the use of Mitchell's Screw Piles appears to have been attended with remarkable success, but their applicability, it may be suspected, is far from being universal. They are admirably adapted for positions in which the piles are required to resist an effort of tension; because in such cases they cannot forcibly be drawn by a direct pull, unless at the same time the prism of earth around them is displaced. Where it is desired also to drive piles to a considerable depth in a semi-elastic stratum for the purpose of resisting a lateral strain, rather than an insistant weight, Mitchell's Screw Piles have great advantages over others for these reasons: first, they can be made to descend with greater ease and certainty; and secondly, they can only be displaced, in this case also, by the removal of the surrounding prism of earth. If, however, the use of piles be resorted to principally for the purpose of producing compression of the subsoil, it may be expected that this effect will not be attained so satisfactorily as by the old mode of driving, because the gradual and easy descent of the pile confines the lateral compression of the ground to the immediate vicinity of the pile itself. I am not aware of any direct experiments upon the resistance of these piles in peat, or soft compressible mud of indefinite thickness, of a similar nature to those alluded to in the case before cited of L'Orient, in which piles with the but-ends downwards were used.

Dr. Potts' system of driving piles by atmospheric pressure, before alluded to, originally consisted in the use of hollow tubes of cast iron, open at bottom and able to be closed at top; the open lower end of which was placed upon the surface to be traversed. When the tube had descended as far as possible by its own weight, the ground in the interior was extracted, and the tube being placed in communication with an air pump a species of vacuum was formed. The atmospheric pressure upon

the top then naturally caused the tube to descend, until the compression of the inner air enabled it to counterbalance the weight of the external atmosphere; the earth in the interior was then again removed, and the operation repeated until a sufficiently solid substratum was reached, when the interior of the tube was filled in with concrete. Latterly the tubes have been executed of such dimensions that they ought more properly to be called caissons; and in the foundations of Rochester Bridge, Mr. Hughes is said to have introduced so many alterations and improvements into the system that it would be highly interesting to compare the successive modifications of the original idea, the real merit of which perhaps, after all, should be attributed to Coulomb, who, in the year 1788, published a memoir entitled "Recherches sur les Moyens d'executer sous l'eau toutes sortes de travaux Hydrauliques sans employer aucun épuisement," which contains the germs of much that is assumed to have been invented at later periods. Be this as it may; the circumstances under which the use of open cylindrical caissons appear to be desirable may be stated to be when the compressible substratum is of small depth, and when it is immediately succeeded by a thick stratum of incompressible material. It is essential that the latter also should be of a nature to resist the dissolvent action of water, in case the smooth sides and cutting edge of the cylinder should lead that element to the substratum. Upon railways, to quote one instance of the situations in which these cylinders might be used, it may be necessary to cross a long, semi-fluid bog—as upon the Munich and Augsburg line. The system actually adopted there was to sink holes through the peat, in alternate squares like a chess-board, about 2 feet wide at the bottom and 3 feet at the top, the average depth being about 15 feet: these holes were filled in with puddling clay, and the embankment was carried upon them. In this particular instance the peat was sufficiently solid to allow of the holes being cut and left without any support; and to resist the lateral displacement of the clay. Had it, however, been similar to many of the Irish bogs, the use of some such caissons as Dr. Potts introduced would have been indispensable, and, perhaps, it would have been preferable to have sunk them by pneumatic pressure, rather than in any other way. Our Trans-Atlantic brethren content themselves with carrying their railways over such foundations upon common piles, partially driven into the ground, and partly standing above it—a mode of proceeding which may answer in countries where it is essential to keep down the first cost of such enterprises, and where wood is sufficiently cheap to render it unnecessary to regard its waste. But evidently piles thus partially exposed and partially covered up are liable to rot with great rapidity.

In these remarks I have not attempted to draw any comparison between the various methods of forming artificial foundations; simply for the reason that the investigation of the circumstances which would render it advisable to resort to the exclusive use of either concrete, timber platforms, or of piles, is of so wide and complicated a character that it would require far more time than we can at present devote to it. If, however, it should appear to the Members of the Institute that the subject offers sufficient interest to induce them to devote another evening to the consideration of this branch of construction, I shall be extremely happy to bring it again under their notice. Indeed, I have designedly dwelt in a superficial manner upon the application of Dr. Potts' system, and the general use of caissons, because they would in fact be better discussed concurrently with the general question of Artificial Foundations, than in connection with the more limited one of Pile Driving. The difficulties and the phenomena attending the latter class of operations were the reasons which induced me to call your attention to them previously to bringing before you the consideration of the circumstances under which they occur.

ERRATUM.

In Paper of June 11th, page 111, line 16 from top, omit the word *suppositious*, and read—*case that occurred in his own practice.*

APPENDIX.

29, Clipstone Street,
15*th January*, 1855.

Dear Sirs,

During a recent perambulation in the County of Surrey, I was pleased to find that Kentish Rag-stone may be procured from a locality about twelve miles more westerly than any that had heretofore come under my notice; and as a new source of supply, of a well known building material, may be advantageous to your profession, I am induced to offer these few remarks to the notice of the Institute.

At about one mile and a half south of Godstone, the bottom beds of the lower green sand formation rise suddenly at an angle of nearly 45o, presenting decisive evidence, either of a sinking towards the chalk, or of elevation in an opposite direction, to form the escarpment of Tilburstow Hill. This stone contains a superabundance of quartzose grains of sand, often angular or slightly rounded, interspersed with very minute plates of mica, and scarcely any carbonate of lime. The strata vary in texture and composition, from the state of soft sand-rock to that of irregularly shaped nodular masses of great hardness, in most cases tinged with oxide of iron, of various shades, from whitish gray to a deep ferruginous brown. The transition is sometimes very sudden, from loose sand into compact stone of a dark gray colour, in which the original sandy structure is scarcely discernable; in other specimens the gradations are almost insensible. Between some of the beds, clay, having a smooth and saponaceous feel, is rather abundant; it is, in fact, a kind of "*Fuller's earth.*"

In their geological position, the rocks of Tilburstow Hill correspond with those from which the "*Kentish Rag-stone*" is procured in the neighbourhood of Maidstone, or through the central part of Kent, and in some of the minor features they are similar. The softest sand-rock of Tilburstow quarry may fairly be considered identical with the "Hassock" of the Kentish Rag district; and if the harder varieties were removed to London, or to a distance from the quarry, I doubt whether the most experienced mason, or learned mineralogist, could detect the difference between this mineral and its counterpart from the Rag-stone district of central Kent.

Therefore, as the Kentish stone and that from Tilburstow Hill correspond in all essential qualities, and as the former is so thoroughly well known for architectural works, it will be useless to dwell further upon the subject; suffice to say, that the two materials may be used under the same circumstances, for similar purposes, in the same or other building, without prejudice to the edifice in any way whatever.

A new Aisle, on the south side of Godstone Church, has been built with this stone during the last two or three years.

I remain,

Your respectful and obedient Servant,
C. H. SMITH.

To the Honorary Secretaries of the
Royal Institute of British Architects.

12, *Avenue Road,*
January 27th, 1855.

My dear Sir,

I have hoped to gather some information from an assistant, who was engaged for some time at the church at Chesterfield. He has read the paper and discussion, but I do not know that he has very much to add to what has been said. He took the exact amount of deviation in 1842, which he found to be 6 ft. 6 in. southward and 2 ft. 6 in. westward. This seems to exceed that found to exist by earlier observers, and strengthens the supposition that the evil is on the increase.

There can be, I think, little doubt that the primary cause was the heat of the sun on the south and west sides, which warped the timbers, drawing them in the direction of the heated side. It may have been increased at a subsequent period by decay, but this could not have been the original cause of the framework throughout its entire height having sustained this extraordinary twist, for the deviation from the true form is anything but a simple inclination. It is a twist, very similar in kind though differing of course in degree, to the horns of some animals, and appears to change with every point of view. I have no doubt that the spire was built of green timber, which being also needlessly large, was affected to a very extraordinary degree by the sun. I may mention that nearly every timber spire has some tendency to bend to the south-west.

There is a remarkable instance of the lightness of which a timber spire is capable, when carefully framed, in that of the Church (I think Wren's) in Rood Lane.

I remain, my dear Sir,

Your's very faithfully,

GEO. GILBERT SCOTT.

C. C. Nelson, Esq.

PAPERS

READ AT

The Royal Institute of British Architects.

SESSION 1855—56.

USUI CIVIUM, DECORI URBIUM.

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SOME REMARKS ON THE PRESENT CONDITION AND FUTURE PROSPECTS OF ARCHITECTURE IN ENGLAND.

Made by W. Tite, Vice-President, M.P.

At the Opening Meeting of the Session, 1855-56, of the Royal Institute of British Architects, November 5, 1855.

Mr. Tite commenced by observing that it had been generally the practice, at the Opening Meeting of the Session, for the Chairman to make a few observations on the principal events which had occurred during the recess: he himself had occasionally followed that course, but on the present occasion his thoughts had been turned in another direction, and he had, therefore, announced his intention of occupying their time with some remarks on the present condition and future prospects of architecture. He had been much led to this subject by an incident which occurred at a recent meeting of another society, the Architectural Association. At their first meeting, about three weeks since, he was a visitor. The association was a body of young men who met to prosecute their studies, and with one of whose suggestions he had been much pleased. It appeared that the members felt the necessity of something like a diploma, or some other recognition of their attainments, and that they were willing to submit themselves to an examination, in order to obtain an opinion on their professional merits and attainments. He (Mr. Tite) thought this was a step in the right direction. The association, when he attended its meeting, was addressed by the chairman, a man of considerable talent, Mr. Bailey, in a very able and suggestive address, embracing much that was wanted by young men about to embark in an anxious and arduous profession; and the suggestion he had referred to was one which had strongly commended itself to him,—and he could not but regard it as a remarkable fact that these young men should feel it so desirable that their attainments should be recognized, that they should offer themselves voluntarily for examination. It was an important step n the history of their art. As Mr. Bailey had said, if they were exposed to competition, that competition could only be met by showing that architects possessed superior attainments beyond the reach of those with whom they had to compete for public favour.

In considering the present position of architecture, Mr. Tite could not but advert to what it was when he first embarked in life. At that time the number of architects who had any claims to the title amounted in London to about fifty; and there were not more than four or five leading men: to one of those he was articled. It was then the custom to devote six years of a young man's life in that way, —and that was a concession of one year from the ordinary period of seven years' apprenticeship. At that time there was a fallacy, which perhaps even existed to some extent at this day, that it was necessary to send a young man who desired to be an architect into the carpenter's shop,—or as it was technically called, he went for "three years to the bench." He could hardly conceive how three years could be more completely wasted. The idea of sending a lad from school into a workshop to be qualified at the end of the term only in a very imperfect way to put together a door or sash, did appear to him to be a most extraordinary waste of time. Luckily for himself and his friends, he escaped the ordeal. He served his articles, he hoped, faithfully and honestly, for six long years. In the present day he believed the practice had erred in an opposite direction, and it was now the custom to article a youth for three years only,—in which time very little could be learnt. Formerly, the opportunities which an architect had for study and improvement were few and costly. There was abundance of information of great value, but it was scarcely attainable; and the first move that was made to obtain

information was by means of an Architectural Association, where a few earnest young men met together to make a design or a sketch from a given subject, or to discuss a short paper read by one of the members. That association memorialized the Royal Academy for literary assistance, and the Royal Academy opened their library to them once a week; and there they had access to books which were otherwise not within their reach. On looking through his own library he found that there was no want of books at the time referred to, which would teach a man the elements of his profession; but they were costly, and in some instances somewhat scarce. In 1762, Stuart published the first volume of his "Athens:" the second volume was published in 1787, and the third in 1794: the first volume of the "Ionian Antiquities" appeared in 1769, and the second in 1797; "Palladio," by Leoni, in 1715; and Adams' "Spalatro," in 1754: Chambers' Elements of Architecture were published in 1759, and he was building Somerset House in 1774. The well-known work of Desgodetz, "Les Edifices Antiques de Rome," was published in 1682: but all these books were very costly, and at that time there was no institute or society through which the information which those books contained could be reached by ordinary students. With regard to Gothic architecture, there was the work, "Vetusta Monumenta:" Carter commenced his "Ancient Architecture" in 1795. Britton produced the first volume of his "Antiquities" in 1806; and the fourth volume in 1816; and he commenced his "Cathedrals" also in 1816. But there were no books generally accessible, and the young architect had enormous difficulties to encounter. At present every kind of information was easily obtained at a very trifling cost. Among the earlier steps leading to this result was the foundation of the Architectural Society in 1831, under the patronage of the Duke of Sussex. The Institute of British Architects was later in point of time, and it was unfortunate that the profession was separated by the existence of two institutions. He himself joined the Architectural Society, and after some years became its President, and when the proper time arrived, he did his best to promote the union of the two societies, which was eventually accomplished. The Institute was founded in 1834, and obtained its charter in 1837. In 1835 they received Sir John Soane's donation of £750.; in 1842 the two societies were united; and in 1848 the Queen first bestowed the Royal Gold Medal. At the time of the foundation of the Institute, it consisted of twenty-five fellows and subsequently fifteen associates; and although he had to regret that the members were not more numerous than they were at present, he still thought that on comparing their present with their original numbers, and considering the many eminent men who had joined them, they were justified in congratulating themselves on their present position.

The next question that occurred to him in looking at the present position of architecture, was to inquire what was the influence of the Institute at the present day. Upon the profession itself, he believed that it was considerable and important. At the Institute the student had access to a valuable library, to lectures and discussions, and he believed that there were advantages in connection with it for the promotion of their architectural position, which without it they would altogether have failed to obtain. With regard to its influence upon society, though it would be wrong to assume that the Institute had its proper position among the literary bodies of London, it had obtained a certain amount of influence, which had been apparent in two recent instances. One was in reference to keeping the land on the south-east side of St. Paul's open for the public. The Institute moved in the matter, and appointed a Committee, and the public attention which they were able to call to the subject had, he ventured to hope, secured that great object, almost national in its importance. This was mainly to be attributed to the influence of the Institute as a united body. The next instance was the Building Act. The old Act, which, as they knew, was very imperfect, had existed for ninety years; but no two men could agree in amending it. About ten years ago, however, the Government brought in another Act, which was very complex in its machinery, and under which it was very difficult to obtain a decision on

any contested point. The late lamented statesman, Sir William Molesworth, had the courage to undertake the matter. He only regretted that Sir William Molesworth had not been spared to receive the congratulations of the Institute for having successfully combatted the difficulties which surrounded the question. In that matter the Institute had made its influence felt. He had the pleasure of being the chairman of the committee on that subject appointed by the Institute, and although he began by opposing the Bill, he became so satisfied of the perfect sincerity of Sir W. Molesworth, and of his desire to make the Bill useful and workable, and to adopt any reasonable suggestions, that in the end he became a warm supporter of the measure, and by a train of fortunate circumstances had the honour of becoming a member of the Parliamentary Committee itself, and of assisting in passing the Bill. He did not mean to say that everything was done that might have been done, but by sweeping away the complicated machinery of the previous Act, a great deal of good would doubtless be effected. The only unfortunate parts of the Bill were the clauses introduced at the instance of the builders in opposition to the architects, and those clauses he believed would lead to difficulties hereafter; but he did claim for the Institute, as a body, that its influence in the question had been felt, and the Institute was now in the position of being the examining body for the District Surveyors. It was a great step in advance that their position should be so acknowledged. There had been some difficulty in passing this provision of the Act. It was strongly opposed (he knew not why) by the present Duke of Somerset (then Lord Seymour), and supported by Lord John Manners; for which courtesy he was bound to thank his lordship, as well as to congratulate the Institute that it was now the law of the land.

He would now pass to the effect of the Institute upon architecture generally, and in that respect he thought they had nothing to be ashamed of. In visiting the French Exhibition, he had endeavoured to ascertain whether they were behind-hand with their neighbours; and with every desire to exempt his mind from national prejudice, he thought there was nothing to be seen in Paris, in the more recent productions of the French artists, to make English architects ashamed of the comparison. In London, he thought that the architects had done well, and, to use a common phrase, had held their own. As very recent instances, he would quote the British Museum, and the new Palace at Westminster. In the latter all that the most refined taste and anxious industry could effect had been accomplished. Those who chose the style had to answer for that choice; but the work had been carried out with taste and judgment, and Sir Charles Barry had entered most thoroughly into the feeling and spirit of the Gothic architecture of our ancestors. As to German architecture, the great works of Klenze, of Munich—the Walhalla, the Glyptothek, and the Pinakothek,—were splendid specimens of modern art, but his attempts at Gothic were absurd. The Museum at Berlin was a great work of Schinkel; but his "Entwurf" for the church of St. Gertraud, was so wretched that it was well for the city of Berlin that it remained only a project. In St. George's Hall, Liverpool, architectural decoration had been carried to a great extent, and that building was certainly quite upon a par with the works of any of the French architects.

With regard to modern Gothic architecture, it was difficult to compare that of France or Germany with that of England; perhaps because English Gothic, as seen in our best examples, as Westminster, York, Salisbury, or Beverley, was peculiar in taste and detail, and differed from the Pointed architecture of France or Germany. But, upon the whole, he considered modern French Gothic very inferior indeed to that of England, in its general effect as well as detail. He thought the church of St. Clotilde, on the whole, a failure; and he had seen a church in course of construction, in Paris, near the Faubourg Poissonnière, in which there were cast-iron columns and cast-iron ribs, filled in with plaster, in such a manner as would not now be tolerated for a moment in England.

He was of opinion, however, that Gothic architecture was too fashionable in England; and he sincerely regretted it;—partly, perhaps, because of early teaching, and perhaps because his recent visit to Italy had revived his old impressions. Classical architecture appeared to be almost forgotten by English students; and he had been exceedingly struck by the fact, that in a clever and well-written book, by an architect, on "The Gothic Architecture of the North of Italy," classical architecture was ignored and despised. This was a sign of the times which, as an architect, he was bound sincerely to regret. At one time English architects had been mad for Grecian architecture; but now both that and the great works of Wren, Palladio, Inigo Jones, and the great architects of Italy were neglected; and one gentleman (Mr. Ruskin) admired to the very echo the Ducal Palace at Venice—a feeling which he regretted should exist among the architects of England. The writer of the book to which he referred had engraved, as a beautiful example, a window in the very angle of the main story of one of the principal palaces; to effect this the angle was cut through, and the upper part, of very heavy architecture, was supported on corbels only a few inches thick. He had himself been taught that the weight should be carried consistently and honestly; and so violent a departure from that rule as this and many other instances he could quote in Venice, he could not consider consistent with architectural truth. He thought that architects and architecture were much indebted to Mr. Ruskin, but he regretted that his lot had been cast in Venice; for of all the ugly types of Gothic architecture to be found on the continent, that of Venice was, in his opinion, the most ugly; and although he agreed with Mr. Ruskin and Mr. Street that the origin and progress of Gothic architecture might be traced in Venice more successfully than elsewhere, his own opinion was, that the Venetians never attained any eminence whatever in that style of architecture, and that all that could be claimed for it was a certain amount of picturesque prettiness. He did not know whether these views were acceptable to the meeting, but he wished to recall the serious attention of the profession to the beautiful architecture of Italy, and its exceeding fitness for English religious observances; its facility for accommodating large numbers, and enabling them to join conveniently in the service, and to hear the sermon. At the same time he did not undervalue our attainments in regard to Mediæval architecture, of which, especially in regard to decoration, we had every reason to be proud; and which contrasted favourably with those of French architects.

He wished he could speak in similar terms of the public improvements in London, on which, it is true, enormous sums had been expended; but the French had done the same thing in a way which put English parsimony to shame. The tower of St. Jacques, as restored, and forming the centre of a large open space, constituted one of the finest objects in the magnificent new street in Paris, and redeemed it from tameness and monotony. This fact, together with the noble space round the Hôtel de Ville, showed there was an amount of taste and liberality in Paris which it would be well to imitate in London. The difficulty the Committee of the Institute had had to contend with to secure the vacant ground at St. Paul's was a matter for which the people ought to take shame to themselves, when contrasted with the sacrifices which the French had made for the improvement of their metropolis.

In regard to the present position of architects, it was to be observed that they were now rather in a transition state. Formerly, architects and engineers were not separated as at present. Mylne and Alexander, both architects, constructed Blackfriars Bridge and the London Docks; and if the engineers had gone a-head of the architects in later times, it was the fault of the architects themselves. They were quite able to help themselves. Every gentleman present might be an engineer, an architect, a builder, a decorator, or anything he pleased. The difficulty he had referred to was to be met simply by superior attainments on the part of architects; bearing in mind that in England men would always be estimated in proportion to their practical ability.

With regard to the future prospects of architecture, the great object to be desired was a test, by examination, of the ability of its professors; and he hoped the time would come when the Government would employ architects and engineers because they were recognized by their professional brethren, and an architect would be honoured because he had passed an examination before the Institute of British Architects; and the more so if they went to that examination voluntarily.

Mr. Tite proceeded to read the substance of the qualifications required from architects in Prussia, who were subjected to a strict examination in literature and general and technical science, the examination being oral, public and competitive.

He believed that those who, like himself, had practised as an architect for thirty years, must feel that, after a time, most of the things included in the Prussian regulations would be demanded of English architects; and he hoped that some system of examination would be carried out, for upon that alone would depend the advancement of the art. There was no other mode of getting "the right man in the right place," than to let the right man be properly informed of what he had to do. The Council of the Institute had authorised him to state, that some of the topics which he had introduced to the meeting should form the subject of discussion on some future evening. In the meantime he must congratulate the profession on the progress it had made (and particularly on the offer of the younger members to submit themselves to a voluntary examination); and would urge them to consider carefully the comparative merits of Mediæval and Italian Architecture.

On the motion of Mr. Fowler, Fellow, the thanks of the meeting were voted to the Chairman for his address.

General Abstracts of Regulations for Architectural Education and Examination at Berlin—translated from the Original Papers—referred to in the Address of Mr. Tite.

Regulations for the Royal Architectural School at Berlin, 1849.

1. Title, &c.
2. The School is under the Minister of Trade. A Committee manages the details, consisting of a Managing Director, named by the Minister, and two members of the Upper Board of Works one for Architecture proper, the other for Civil Engineering.
3. The regular Lecturers are appointed by the Minister on a recommendation from the Committee.
4. Extra Professors, &c. may be appointed by the Committee for special purposes.
5. Applications for admission must be made in writing four weeks before the commencement of each Half Year (8th October and 8th April).

   In October of each year a new Series of Lectures, &c. will be commenced.
6. On application for admission the following certificates must be brought:—

   I. By those who wish to enter Government service—

   a. That they are first class men in some approved Gymnasium, &c.

   b. That they have had at least one year's practice under one or more Architects.

II. By those who only wish to become Private Builders—
That they have passed the prescribed examination for Masons or Stone Cutters, and Carpenters.

7. Foreigners will be admitted (on same terms) so far as there is room.
8. A Fee of Ten Dollars is to be paid upon matriculation. The course of study will at first be fixed for five years, but the term may be extended by the Director.
9. Relates to details about attendance of the Students at the Lectures (*i. e.* They must at the commencement of the Half Year signify what Lectures they purpose attending, and upon payment of the Fees they will receive Tickets of admission).
10. If there is room the Director may grant admissions (on payment of the fees) to specific Lectures to any person, not a Student.
11. Upon request the Students may have certificates as to the Lectures they have attended.
12. The Half-yearly Sessions commence on the 8th October and 8th April, and close on the 20th March and 31st October. A week's holiday at Christmas, Easter and Whitsuntide.
13. The Lectures are so arranged that the Surveyor's course may be completed in two years, that of Architects proper in one, and that of Civil Engineers in one.

Course of Lectures at the Royal Architectural School in Berlin.

Winter Session, 1851-2.

N.B. The Fees are all calculated at the rate of a three-quarter dollar (2s. 3d.) per hour of Weekly Instruction.

		Hours per Week.	Fee in Dollars.
1	Stereometry, Spherical Trigonometry, Analytical Geometry	4	3
2	Simple Analysis, Differential Calculus, Law of Curves	4	3
3.	Descriptive Geometry	6	4½
4.	Physics, with relation to Heat, Light, Electricity, and Magnetism	4	3
5.	Chemistry, with relation to simple materials connected with Building	4	3
6.	Construction of Buildings, Drawing	6	4½
7.	Antient Architecture, Application to present Time, Outline Drawing, first part	8	6
8.	Line and Architectural Drawing, first part (Ornamental Drawing)	4	3
9.	Dynamics, first part	10	7½
10.	Planning and Drawing Buildings, first part	4	3
11.	Farm Buildings, with internal arrangements	6	4½
12.	Antient Architecture, third part (Drawing)	6	4½
13.	Line and Architectural Drawing, third part	4	3
14.	Elements of Road and Bridge Making, and Hydraulics, first part	3	2¼
15.	Machinery	6	4½
16.	History of Antient Architecture	6	4½
17.	History of Architecture when the arts flourished in Italy	6	4½
18.	Drawing from Models, &c.	6	4½
19.	Plans of Public Buildings	4	3
20.	Ornamental Drawing, first part	4	3

		Hours per Week.	Fee in Dollars.
21.	Doctrine of Probabilities (applied to the Theory of the correctness of Observations)	4	3
22.	Hydraulics and "Waterworks" in general - -	12	9
23.	Railways - - -	3	$2\frac{1}{4}$
24.	Machinery - - -	8	6

The EXTRA LECTURES comprise—

Further practice in the Differential Calculus, Conic Sections, Integral Calculus, Warming and Ventilating Buildings, History of Greek Architecture, Colored Decorations, Greek forms of Art (Buildings, Vessels, Implements), English, French and Italian Languages, Short Hand.

REGULATIONS FOR CANDIDATES, 1849.

1. The degrees of proficiency are—
   - I. Surveyors.
   - II. Architects.
     - *a.* Architects proper. *b.* Civil Engineers.
   - III. Builders.
2. Relates to the certificates to be handed in by Candidates for the Surveyor's examination.
3. If these certificates are found satisfactory the Candidate will be examined.
   - *a.* On the scientific and technical subjects which are the basis of the further studies of Building Students.
   - *b.* On knowledge of Land Surveying (no long practice required).
4. Relates to the certificates to be produced by Architects and Builders.
5. If these are satisfactory some suitable design will be entrusted to the Candidates, proper time and means of assistance being afforded.
6. After this is completed the examination will take place.
7. The Royal Upper Board of Works ("Bau Deputation") constitute the Board of Examination, but the Minister of Trade may appoint additional Examiners if he think fit. Their report is to be confined to the results of the particular examination, specifying each department of the subject.

   The viva voce examinations are public, and the drawings, &c. of the Candidates are at the same time to be exhibited. Unsuccessful Candidates are allowed a term, after which they may try again; failing again no further trials will be allowed.
8. The Surveyors when sworn are competent to manage the execution of Plans, under the supervision and technical responsibility of an Architect. Their statements as to size and quantities are to be relied upon (*i.e.* as evidence).
9. Surveyors who only wish to become "Road Inspectors" need not pass the Architect's examination, if they can prove a five years' satisfactory practice in Road making.
10. Architects may undertake the completion of designs, &c. on their own responsibility, and are competent to fill any suitable Government office.

    Builders may execute designs on their own responsibility, but only for simple "Country Architecture" ("nur für die Gegenstände des Landbaues.")

    They are not eligible for Government appointments, and may only fill a "Communal" office when that does not require attention to Roads and "Water Works" (Wege-und Wasser-Bau).
11. Surveyors, Architects and Builders may only execute such Land Surveys as are immediately involved in the practice of their profession.
12. Architects may only carry on any Building Trade (Carpenter, Mason, &c.) on their own responsibility, when they have passed the examination for the trade in question.

Mode of Procedure at the Examination of the Candidates.

1. Examinations for Surveyors take place half yearly after the close of the Lectures at the Royal Architectural School in Berlin.
2. Candidates must prove—
   a. That they come from the first Class of a Gymnasium, or of one of the "Real-schulen," approved by the Government.
   b. That after leaving school they have had one year's practice, in Counting-house duties and in out of door Building work; and that, after this—
   c. They have passed through a course of two years' study at the Berlin Architectural School, or one of the affiliated Establishments; in which case the course of study must be stated in detail.
3. Candidates must also hand in—
   d. A plan of a Plot of Ground with Buildings, at least 5 acres extent, to a scale of 4 rods to an inch; also a Table of Levels with drawings (100 rods in length will suffice).
   e. Sketch of a Building or a Machine, slightly colored with indian ink.
   f. Other dawings, among which the Perspective of a Building, or an Ornament, must be clearly shown.
4. In cases where the preceding are not satisfactory, or cannot be rectified in proper time, the Candidates must wait till the next Half Year.
5. Relates to time for the Examination.
6. The Examination commences with one week's work in private; and in the succeeding week follows the viva voce Examination, lasting two days. According to the result in unsuccessful cases, a period of six or twelve months will be fixed, after which application may be renewed.
7. See also c § 8. Relates to the swearing in of Surveyors, merely provided that they are to be sworn before the Royal Building Commission, if they have not been previously examined and sworn as Land Surveyors.
8. Candidates for the Examination for Architects must prove—
   a. That they have passed the Surveyor's Examination.
   b. That they have been actively engaged under one or more Architects for two years.
   c. That they have passed through at least one year's course of study after their having been examined for Surveyors. So that no person can become an Architect within three years of his having become a Surveyor.
   d. That they have had proper practice and experience in Land Surveying. (The superficial area must not be less than 500 acres, or if difficult, at least 200, and about 1000 rods of levelling).
9. Candidates for the Builders' Examination must prove—
   a. That they have passed the Masons', Carpenters', or Stone-cutters' Examination; and—
   b. With respect to course of Study, the same as in § 2 c.

10, 11 and 12. Relate to the time to be fixed for the Examinations.

13. Candidates for Examination in both Branches (Country and Decorative Architecture, and Civil Engineering) must in addition to the preceding (§ 8) prove—
   a. That they have practically learnt the Trade of a Mason, Carpenter, or Stone-cutter.
   b. And have gone through a three years course of Study after having been examined for the above Trades.
14. Unsuccessful candidates will be told when they may apply again for examination. If they are unsuccessful a second time no further application will be received.

By a Supplement to the above it is enacted that the Integral and Differential Calculus shall, after 30th September, 1851, form part of the Examination of Surveyors—the same being now taught in the Architectural School.

EXAMINATION SUBJECTS.

I. SURVEYORS—(BAU-FUHRER).

Mathematics proper—

a. Algebra, Analysis (simple), Logarithms.

b. Geometry, Stereometry.

c. Descriptive Geometry, Projection, Perspective, Shadow.

d. Trigonometry, Superficial and Spherical Elements of Law of Curves, Conic Sections, Cycloids, Proficiency in Algebraic and Arithmetical Calculations, and in Use of Logarithms, and in Use of the Methods of Descriptive Geometry.

Practical Mathematics—

a. Land Surveying, Levelling.

b. Elements of Statics and Mechanics, Acquaintance with the Standards of Measure, Hardness, Friction, Strength, &c.

Natural Sciences—

a. Physics and Chemistry (relating to materials used in building).

b. Mineralogy and Geology, Signs and peculiarities of Minerals used in Building.

Country Architecture, (Landbaukunst)—

a. Knowledge of Materials, their Peculiarities, means of Obtaining and Preparing them, when taken from the Vegetable World, their Botanical relations.

b. Acquaintance with the simple construction of all Buildings (Baugewerke).

c. Construction and Arrangement of simple Dwellings, Farm and Factory Buildings, Lime and Brick Kilns, &c.

d. Antient Architecture, Forms of, and application to Buildings of our time.

e. Making Plans and Corrections, (Revisions-nachweisungen).

Road and Railway Making; Waterworks (*i. e.* Buildings or Works in, or at, the Water)—

a. Foundations in Water, Bridges, Embankments, Tide-walls, Mill-races.

b. General Earthworks necessary in making a Railway, with Plans, Sections, &c.

Construction of Engines and Machines, composition and working of those most frequently used in Building,—Mills, Steam Engines in general.

II. ARCHITECTS.

A. For Country and Decorative Architecture.

The principal styles of Architecture of all Countries and Ages, Peculiarities and Advantages.

Laws of Construction, applied to large and difficult designs, Apparatus for Heating, Ventilation, Cooking Washing, Drying, Filtration, &c.

Dynamics.

Decorative Architecture, in all its branches, for Public and Private Buildings.

Business Arrangements, generally during progress of works.

B. Waterworks, Roads, Railways—

Analysis (compound), Law of Curves, Probabilities, Land Surveying;

Analytical Dynamics (applied to Nos. 3, 4, 5.)

Waterworks, (Wasserbau)—

a. Waterworks in general; Atmospheric Products; Springs; Irrigation; Drainage; Foundations, &c.

b. Making Canals, &c.; Flow of Water in Beds of Rivers; Hydrotechnic measurements; Means for Regulating the Current; for Making Rivers Navigable; Cleansing and Deepening the Channel; Wears; Floodgates; Rafts.

c. Making Dikes; Drainage of Embanked Low Lands; Draining Machines; Sluices; Breaches in the Dikes.

d. Land Communications; Ferries; Bridges of Wood—Stone—Iron.

e. Erections by the Sea; Succession of Waves; Ebb and Flow; Currents; Strengthening or Securing the Shores, Harbours, Moles, Docks, Sluices; Securing Roadsteads and Lighthouses.

Construction of Engines—

Knowledge of different Forces; Arrangements for their Use; Winches; Levers; Water Wheels; Windmills; Steam Engines; Machines for Rubbing, Crushing, Tearing, Pressing and Condensing Building Materials, &c. &c.

Construction of Railways—

Works under ground with Bridges over; Works above ground; Ascents and Curves; Optic and Electric Telegraphs; Precautions against Snow and Quicksand; Stations, with all Buildings belonging; Plant and Rolling Stock.

III. BUILDERS.

The same II. A, 1, 2, 3, 4 and 5, reference being made when required to the points mentioned sub I.

The examination in Mathematics will not be confined to mere theories, but special cases will be given, the treatment of which will show whether these theorems are clearly understood.

One Week will be devoted to Exercises done in private; on the first day, a Sketch must be handed in, the chief outlines of which must be adhered to afterwards.

CONSIDERATIONS UPON SOME OF THE OBJECTS CONNECTED WITH ARCHITECTURE IN THE EXPOSITION DES PRODUITS DE L'INDUSTRIE, AT PARIS, 1855.

By John W. Papworth, Fellow.

Being Extracts from a Paper read at the Ordinary General Meeting of the Royal Institute of British Architects, November 5th, 1855.

With the same view that the results of investigating the productions connected with architecture in the Exhibition of 1851, were submitted to this Institute by the proposer of that step, he has now the honour of presenting his impressions as to similar objects in the Exposition of 1855: but the duty will this time be less completely performed; because there was an absolute impossibility of seeing (not merely looking at) every thing in the short week which he could devote to it, as well as because under that circumstance, the observer goes to such an Exhibition with impressions already formed, and cannot dwell long enough, except in very peculiar cases, upon single objects to modify the opinions with which he is prepossessed. To have dealt satisfactorily with everything relating to our profession in the various buildings, would have required a corps of architects: the building contrivances appeared to be comparatively few in number, and collectively of little value; and, therefore, these remarks will be chiefly confined to the materials and the taste shown in decoration.

As a general idea of the contents of the Exposition, it may be stated, that the number of exhibitors from—

France and its colonies, amounted to about . .			10,691
England	1460		
Its Colonies	985		
	——	2445	
Other countries		7574	
Of which—Prussia, 1313; Austria, 1296; Belgium, 686; Spain, 568.			
		——	10,019
			20,710
In 1851, about . .			17,000

The French classification of the Catalogue, as ought to be expected, is a refined one, but less suited to the ordinary observer than that of 1851. The Catalogue of 1851 was best fitted for an exhibition, that of 1855 for a museum; and something better might be made from a fusion of the methods. Those who understand the effect which is produced upon the public by the information that distinctions have previously been awarded to the producer of the articles at which it is gazing, will certainly regret with me that the English commissions did not add to the names of their exhibitors a list of previously earned distinctions. In the foreign divisions, the Exhibition medals and notices of Berlin, Berne, Dresden, Florence, Genoa, Gotha, Lausanne, Leipsic, London, Munich, S. Gall, Turin, Vienna, and of France, of all time that any exhibitor could claim, were paraded, and with no slight effect.

The *service du Bâtiment* comprehended the design and general arrangement of the buildings externally and internally. The chief names which appear in the official list under that head, are those of MM. Vaudoyer, as Commissaire; Rossigneux, as Commissaire adjoint, with the special care of the decoration; De Crémont, as Architect, with the maintenance and decoration; and Trélat, as Architect Engineer, with the maintenance and decoration of the gallery (the annexe) on the quay. But I cannot suppose that it was owing to these gentlemen that so many architectural models and designs were not in the Exposition des Beaux Arts; an arrangement which caused several meritorious productions to be

lost in the crowd of manufactures, and too many of them in the darkness which prevailed under the galleries. It would be in some degree unfair to compare the Oriental divisions, as to their cases, with works which have lately been executed here; they bore the impress of haste, although attractive at the first glance. Those to whom the idea occurred of placing the models from Sunderland (of vessels) in glass cylinders, deserve praise for the elegance which their invention displayed. The cases for the Glasgow goods were pretty, as were the stands for Bennett's watches and Claudet's photographs, but I guessed that they were French productions; as well as the Viennese cabinet of drawing materials, and the handsome bookcases (Renaissance style) in the French department of stationery and printing; the stall of the Imprimerie Impériale, which had a back-board covered with green velvet, and surmounted by a grand cornice with a bratishing upon it, was of course a French production. The very good Elizabethan case, a frame on brackets, for the woollen stuffs sent by the Commission Royale de l' Agriculture of Wurtemberg, was one of the best cases in the building; and the bamboo stall, 20 feet in diameter, of the Société Néerlandaise de Commerce, was pretty. The Prussian zinc work and the Austrian electrotyping, will be named. The Australian book-cases, if made by Marsondet and Son from a design by M. Semper, were certainly not creditable to the skill of either the designer or the manufacturer. The English fittings in 1851, presented a great contrast to those on the foreign side, where government authorities did almost everything for the exhibitors, and massed their work in decorated and darkened apartments; but in 1855, the rule was darkness: and this was the more to be regretted, because a general effect of uniformity was produced at the cost of the brilliancy of the productions. The passages under the galleries were so narrow and so gloomy, that visitors were glad to keep out of them and stay in the body of the building, although that also had the effect of being filled with articles huddled too closely together. Very few market prices were affixed in the Exhibition, although information of that sort was invited; and it was impossible not to observe, that where articles were marked with prices, and as "sold," they chiefly belonged to one of three categories—cheapness, trifling prettiness, and direct imitation of natural objects. Thus, the cheaper objects produced by the electrotype process, although not in good taste—the library chairs (upon English models) from Hamburgh,—and the English flower stands, fenders, scrapers, umbrella stands, knockers, and hat stands, were so marked; as well as a majority of the pretentious littleness which was to be seen throughout the building. It seemed that nearly all objects of direct imitation (as sculpture) from nature were sold, however they might be colored, or whatever their material might be; for instance, a bundle of blue canes as an earthenware garden seat, or three apparently leather cushions piled one upon another, in the same material; as well as umbrella holders of birds, cupids, and dogs; plates of leaves; heads of animals as brackets, and many more. Next in attraction seemed to be the objects of every kind in the very simplest condition, such as the productions of Wedgwood; and following them the style de la Renaissance—rarely pure, but mixed with positive Gothic, or with servile copies from nature, or with both—was so prevalent as to seem the fashionable style. This mixture of various styles in a single work was so frequent as to create a feeling of dissatisfaction generally. For what it sent, Spain exhibited as little of this fault as any country; the tables and chairs from our Indian possessions were, as on a former occasion, remarkable for their adoption of styles foreign to the native school, and the spirit correctly infused into them; Belgian industry seemed to exert itself in mechanical rather than in artistic productions, but there was boldness enough in the works produced by Lalmand, of Antwerp, as models for the decoration of apartments, frames, &c. Another Belgian exhibitor submitted a cabinet, costing £ 260., in a mixture of the Elizabethan and Nature styles, which was spoilt by the insertion of marqueterie representing perspective interiors; the works from the Netherlands were generally rococo but clever; while the Austrian and Prussian

tastes were generally poor in effect. I am inclined to place as the first in the whole *Exposition des produits de l'Industrie*, the contributions of the MM. Huber,—they chiefly consisted of a chimney piece and frontispiece over it, in the *style Le Pautre;* but there were other works from the same hand, such as the frame to Delepierre's flowers, which amply refreshed an eye fatigued by the general insipidity and poverty of the sculptured ornament in the Exhibition. Magnificence was also obtained in the bronze pedestrian statue of the late King Frederick William III. of Prussia, exhibited by the Institut Royal des Arts et Métiers of Berlin. The figure is represented in armour, inlaid with pseudo or late Etruscan ornaments in gold and silver; to this more marks of approbation were placed in my note book than to any other work which I shall have to name; its effect was not quite paralleled though pursued with much taste by the ecclesiastical dresses from Brussels, the *manteaux de cour* of the Compagnie Lyonnaise, and the pseudo Etruscan embroidery of gold upon blue cloth, sent from England. The two Zuloagas of Madrid stand in my estimation in the next place, for the beauty of design and excellent execution of their armour and other objects in wrought and chased iron. The grand fountain by Barbezat, and the Greek candelabrum by Siegel (correct but not spirited), deserved especial attention; and the exhibition of fifteen sun-dials upon various parts of one pedestal, by Le Tessier of Plessier Grammoire, planted out in the open air where few could remark it, shewed that an almost obsolete branch of science is yet cultivated in France.

The display of natural resources in stones, limes, bricks, slates, and woods, from Australia and Canada, was too important to be passed unmentioned, although I had no opportunity of studying them. I cannot refrain from expressing a hope that our Government will see that it is its duty to endeavour to place those collections in England.

The further course of these notes may be divided into seven portions: the first consists of observations on the use of materials which come within the province of lithology, the second of observations on the application of metals, the third will treat of the use of wood; and then passing slightly over some products of the animal kingdom as applied in manufactures relating to building and decoration, we shall speak of the few building and other contrivances, of the models, and of the Exposition des Beaux Arts.

Putting aside the rich and numerous Australian collections of Mr. Clark and of Mr. Macarthur, and the good collections of small specimens of marbles from Portugal and Tuscany, it will be found that Greece and France produced the chief specimens of marbles. Porphyrite from Crocæa, Rosso-Antico from Damaristica and Cynopolis; Agate-breccia from Xilokeratia; breccia from the Taygetus; the amygdaloidal marble of Parori (Sparta); cipollino from Pyrgari in Lageia; the black marbles of Mantineia and Laconia; the green marbles of Tænus; the red marbles of Cape Tænarus; marbles and breccias from Nauplia; and alabastroidal marble (of which it is said that antique lachrymatories were made) from the island of Psythalia (Piræus); are the names found in the collection forwarded by the Greek Government.

Dervillé and C^ie^ sustained the honour of the French marbles by the collection of fine specimens, of no small size, shown in 1851; and their efforts were seconded by those of Millardet and C^ie^ and of more than forty private exhibitors, of whom ten showed marbles worked up as chimney pieces. This number does not include an interesting collection of the marbles of Corsica; a translucent onyx-marble from ancient quarries at Aia-Teébalek, near Tlemcen (Algeria); a fine marble table of the grey red-veined marble, called rouge-royale, from the quarries at Franchismont; another of a marble from the quarries of S. Hubert, at Roquefort (Luxembourg); nor the ornamental columns supplied by Geruzet. Two productions should have stepped out of the pale of manufactures into the domain of art; one was a clock case, 18 in. by 18, with three groups, costing £80., by Dubois; the other was a

white marble vase, 24 inches high, and 12 inches in diameter, at the same price, by Margas; it was a beautiful, yet bold, Roman design, with flowers extremely well executed. A chimney piece from the same firm was of nearly equal merit, and was the best of the French chimney pieces, which were of a higher class than those sent to this country in 1851; and showed that the mouldings of Vignola are the best suited to the colored French marbles. There were also some very good second-rate chimney pieces, especially one which was marked as the pattern approved for the Mediterranean steamers. Besides the works of three other Belgian exhibitors, there were several chimney pieces exhibited by Leclercq, which were sold—in marbre Napoleon, a grey marble from Boulogne; in brocatelle brun from Dinant, and in Siena (at £84.); the two last being better than a white Carrara marble (at £360.)—The green Connemara marble, exhibited in the English division, appeared to advantage. Tuscany, as might be expected, stood first in the display of the inlaid work, called Florentine Mosaic. Mention should be made, for its size, of the great vase, 5 feet in diameter, and 12 feet high with its pedestal, sent from Bagnères de Bigorre; and a stone, called Portland-stone, from the estate of Portland, in Jamaica, was shown, as turned by common wood cutting tools; there is a similar stone in that island called Southampton-stone: the even texture and extremely clean arris which work in this material presents, would indicate the probability of its introduction here for decorative work. Wurtemburg sent a fine collection of building stones; Cologne Cathedral some work out of the mason's yard over-labored and refined; and Austria a machine for making tubes of stone, a fallacy exploded here fifty years ago. Fourteen establishments contributed specimens of slate raised in France,—there was nothing in these collections remarkable; but I was unprepared for an exhibition of Italian slating: the slates from Sweden seemed of good quality. The English enamelled slate was a specialty. The French division contained about thirty exhibitors of cement and artificial stone; Portland and Roman cements would seem to be equally well known by name on both sides of the channel; and it is remarkable that only half that number exhibited limes, while only five showed plaster. The French scagliola-work appeared paler than such work in England; and, I may add, that my hearers will find that this paleness, the effect of white, is common to every branch of colored continental manufactures. The vases, 30 inches high and 14 inches wide, in a Greek taste, made of chunam in India, were very remarkable.

To say that the twenty French and two or three other exhibitors failed miserably in their painted and stained glass, is only to express the opinion generally pronounced: it is easy to dismiss a whole class with a contemptuous sneer, but it is the duty of those who pronounce such a decision to be able, if not willing, to give the grounds of their decision. The following reasons guided my own judgment. In the class of flashed glass simply, the glass was washy, if there was any pot metal it had the same defect: the artists of the Mediæval ages were so far fortunate that their material, *even when unstained*, was translucent, but only semi-transparent, and therefore looked substantial:* their followers enamel the present transparent glass in imitation of the dirt of ages, which they seem to fancy gives that *solidity* to ancient glass: the fallacy will be evident when it is considered that they seek a "transparent dirt;" and that the semi-transparency of ancient glass is easily ascertainable. As a general rule, the modern works in the Exposition were too much paintings in the strict sense of the word; those artists who age their glass are obliged to cover it with enamel, to put shadows, hatchings, anything that will break the washy appearance of their material, or else to paint it entirely in enamel: this accounts for the prevalence among the exhibitors of imitations of the glass painting style of the fifteenth and sixteenth centuries, and the grisaille-work of succeeding times: but the public says "this is not the lustrous effect of old glass:" those artists who do not age their glass are told by the same

* Information given by C. H. Winston, Esq., Hon. Member, R. I. B. A.

public, "this is tame in comparison with old glass," and the public, without knowing why, is right in both cases. The host of ecclesiologists who besiege our glass painters, torment them fairly enough with the dilemma; from which some of the painters have ingeniously relieved themselves by the expedient of servilely copying some celebrated examples, which are of course irreproachable, and then retaliating upon their critics, "this is an exact copy of your ideal, can you object to it?" The critics, unless prepared to say that the painter cannot even copy, dare not raise a further objection; there is no blame to be thrown upon novelty of design, or excellence of drawing; and thus we may account for the prevalence among the exhibitors of imitators of the stained glass of the earlier periods. Colored glass windows, to be really effective require few qualities, yet they are hardly to be obtained. Solidity of material I have already mentioned; purity of colour remains to be achieved: and when that part of the restoration is accomplished, good drawing will have to combat with the prejudices of this enlightened age, which praises Pre-Raffaellism and manufactures Pre-Cimabuity. What does the friend of Raffaelle and the pupil of Michel Agnolo say? Cimabue was a pupil of the Greek masters, who executed "figures with senseless eyes, outstretched hands, standing on the points of their feet." He departed from the dry formal manner of his instructors, giving "more life and movement to the draperies, vestments, and other accessories, and rendering all more flexible and natural than was common to the manner of those Greeks, whose works were full of hard lines and sharp angles—and this rude, unskilful, and common-place manner the Greeks had acquired, not so much from study or of settled purpose, as from having servilely followed certain fixed rules and habits, transmitted through a long series of years by one painter to another down to those times, while none ever thought of the amelioration of his drawing, the embellishment of his colouring, or the improvement of his design or invention." But Cimabue drew from nature, a new thing in those times, says Vasari; and I may say almost unheard of in glass painting at present. It must suffice to say that some glass painting executed for the Church of Notre Dame at Montbrison, having good modern figures with the drawback of bad color, was exhibited; that the grisaille work was not bad; that an English modern window had the good idea of a lace glass with medallions of arabesque and Renaissance ornament; and that the prices of one manufacturer were per foot square, Grisaille and Byzantine work, 4s. 9d.; modern pictures, 8s.; 12th and 15th century work, 9s. 6d.; 16th century work, 12s.; partly modern and partly ancient, 10s.; glazing, 7½d. or 8d.

The Portuguese porcelain and china ware was good; the great Sèvres Etruscan vase was pale and washy, but remarkable for its size; the Austrian (Hungarian) china was designed with shocking want of taste; chairs of fine earthenware are, I believe, a novelty, they appeared in company with the renewal of a fashion long gone by, viz. the style of vases, ewers, &c., apparently tied in by a string, and left so to dry before firing, this fashion prevails in most French factories; very fine large vases and other utensils from Limoges, the superbly tasteful white utensils exhibited by Jacob and by Ristori, somewhat similar articles by seven other exhibitors, and some sharply modelled china by Schmidt, of Aix-la-Chapelle, formed a large and inviting field for the study of ornamental outline. The fine Swedish earthenware, Ridgway's wash-hand basin, "lavabo" as it is called on the Continent (sold), the plain red and black pottery, the plain ware and Etruscan of Wedgewood (sold), and the fine earthenware stoves from Zurich in a severe Greek taste, excellently managed except for quatrefoils with Italian details, attracted considerable attention. The Swedish earthenware stove-cases were not good. The English pottery vases were equally conspicuous for wretched design and execution. The terra-cotta adjuncts to building purposes were numerous. Fine sharp architectural ornaments in this material were sent from Westphalia, Winterthurn, and Wagram. Large terra-cotta articles, 24 inches square and good, were sent from Karamis in Belgium; and the largest figures in the Exhibition of this

material were sent with ornamental works, by Gossin fils of Paris. Thiry of Paris, and Miesbach, of Vienna, occupied places for figures, vases, balustrades, &c., only inferior to Follet, who sent excellent vases in a Moresque Greek style, and to Garnaud who showed architraves, pretty vases and balustrades; his pattern book is worth inspection. Besides Clayton's brick and tile machine (bought by a member of the Jury) which attracted great attention, and that sent by Whitehead of Preston, there were twelve similar machines in the French division: five exhibitors sent French bricks, and small cement and beton blocks: and there was a large collection of Dutch bricks. Earthenware pipe tubes were not very numerous. The façade built up of his own bricks and tiles, by Borie, made a very pretty architectural display, and was a good lesson in ornamental brick-work. The Florentine tiles appeared to be very good. Madrid sent some pretty and large tiles; there were also very large tiles from Holland; foot tiles, double with cross holes, and earthen sieves. France possessed fourteen exhibitors of tiles in different materials, as clay, glass, iron and cement, and of varied manufacture, encaustic, and in low relief, for paving, &c., for stoves, &c., in the old Renaissance style, and for roofing in many patterns.

In the application of ornamental and sculptural art to the purposes of the goldsmith and silversmith, the English specimens certainly carried off the palm in the estimation of the visitors. Several called my attention to the display made by the Goldsmiths' Company, but it must be confessed that I saw with much more pleasure the exhibition supplied by Messrs. Garrard. A great improvement has been visible of late years in silver work, especially in the styles of Adams and of Flaxman (Etruscan), and the statuettes are not so large. The piece of Moresque gold work for the Queen commanded attention, as did also the cup made by Messrs. Watherston and Brogden; the last seemed more properly a piece of goldsmith's work; the other, from its style of design and size, appeared more valuable as a quantity of metal than as a piece of art; for the more nearly the two values approach each other, the more likely is the labour of the artist to be disregarded, or rather lost in the feelings excited by the material upon which he has worked. Where ornamentation only was employed, the French department, with its delicate and highly finished modelling, stood in the first rank, the parts being larger and the ornament smaller in proportion to the general design than in the works of other countries. I need only mention the Queen's candelabrum, exhibited by Messrs. Elkington, as a proof of the justice of these remarks, which apply in our own profession. Amongst the French productions was an ornamental tablet, valued at £4000., which appeared very satisfactory, and an object of somewhat similar character was furnished from Berlin. The silver gothic chandelier and the crosses from Spain were excellent. The French works generally were scarcely inferior to the rich productions of Maurice Meyer, except in perfection of execution, or to the jewellery work of Beaufour Limonnier, except in regard of the generally good and simple taste therein exhibited.

A very large number of articles in bronze seemed to have affinity with the productions of the silversmith. It would be unfair to rank as works of mechanical art the copies, half the size of the originals, of the gates of the Baptistery at Florence, which we already knew; or the productions by Lechesne, which combined the style de la Renaissance with the direct imitation of nature. The busts exhibited by the Fonderie Barcelonaise, were the most sharp and highly finished bronze castings that I had ever seen, except those from the foundry of the Spanish Government at Trubia, in 1851; they were scarcely equalled by a well-modelled and cast font for Copenhagen, and by the works supplied by Kitschelt of Vienna in the usual mixture of the Natural and Renaissance style. The other works of importance in this compound were French, but the workmanship only was excellent. The well modelled and sharp though not highly-finished Renaissance candelabrum, by Labroue, and next to that the productions of Lacarrière, took precedence in the French division. Mention should

be made of the gothic church chandelier for fifty lights, exhibited by Carrier-Rouge of Lyons; it was, however, not well or steadily put together, and was hung too low to show to advantage.

There were many pretty portions of iron-work in the Exposition: for example, the standards to the Coalbrook Dale Company's stalls; and the signboards, &c., sent by Bouilliant, Dupont and C^ie^ of Evreux; but the first rank in ornamental ironfounding was occupied by a cast-iron pyramidal monument, in a good German taste, sold for £140., and by the gratings, the fans costing £3. each, and the castings from embossed lace papers, exhibited by Count Stolberg Werniugerode; next in rank would be the Eisenwerk Lauchammer, Saxony: the works of Barbezat and C^ie^, for iron and bronze castings, of Colas Frères, and of Muhl Wahl and C^ie^, whose works in the Place de la Concorde are so well known, stood highly in my estimation for taste and execution; with them may be named Eck and Durand, who exhibited, besides a kneeling figure of a princess of no great merit, several fine lamp posts; and Calla, who also sent six fine lamp posts. I particularly name the last two firms, because a member of our profession, whose name I have forgotten, was asking me before my visit the name of a manufactory in which he might find a good selection of handsome patterns for that extreme difficulty—a street lamp-post. The best piece of plain French iron work, on a large scale, was a field gate, in the open air out in a corner of the Exhibition precincts; iron gates also in the open air, an iron fountain in the mixed styles of Nature and the Renaissance, and a pretty railing, claimed particular attention; but their interest was much inferior to the wonderful wrought-iron hinge-work, and similar productions, especially a piece belonging to M. Viollet Leduc, which, if modern, was the best of the sort that ever came under my inspection; the name of the producer is Boulanger, of S. Denis.

The Intendance Royale des Mines et Forêts du Hartz, Hanover, exhibited statuettes, 24 inches high, of the Apostles, for £15. the set; and also a Caminofeu, modelled by Halzemann, which were as excellent of their kind as the other productions from the same establishment were poor. Hanover also sent iron tubing, in lengths of 56 inches each, glazed externally as well as internally. The Swedish iron and steel work was fine, and the castings from Liège were superb in style and execution. Belgium shewed iron plate, stamped with excellent effect, as in 1851, but the iron-work from the Netherlands was neither well modelled nor sharply and cleanly cast; the same bad taste as in its jewellery prevailed in the stamped iron plate from Prussia, which, mechanically speaking, was good. I was surprised to find Florence in the list of cities distinguished for iron casting,—two turnscrew staircases, one with wooden treads, a superb balcony-cantiliver, a lamp-bracket, and a handsome railing, were all of at least the second rank. In 1851 notice was taken of Austrian iron post paper, in the shape of remarkably thin sheet iron, and of Prussian zinc, not thicker than common writing paper. This year France has added brass as thin as tissue paper. It may be a question whether covering wood-work, for example a coruice, as at Berens and Blumberg's in St. Paul's Church Yard, with these substances, would be in conformity with the use of fire-proof materials required by the Metropolitan Buildings Act. The collection of English iron-work was not satisfactory. The design of some of the Canadian stoves, and the carving of their patterns, with castings by Rodden of Montreal, were superior—but their joiner's ironmongery inferior—to the average specimens in England. Some of the English firms which ranked highest in 1851, did not support their previous fame. The chairs exhibited by the Coalbrook Dale Company, in a sort of Moresque Renaissance style, were tolerably good; and the pair of gates, priced by Cottam and Hallen at £240., were fair but flat. The best of this class was Bailey's fine grille. About a dozen plates of iron produced among seven exhibitors by various processes were from $\frac{2}{12}$ to $\frac{5}{8}$ in. thick; from 1 ft. 4 in. to 6 ft. 6 in. wide, and from 14 ft. to 39 ft. 8½ in. long; between 65 ft. and 136 ft. 9 in. superficial, and from 692 lbs. to 3417½ lbs. in weight.

In zinc work, France was chiefly represented by the Vieille Montagne Company and by Baudoin. The latter firm exhibited a handsome hipknob, 4 feet high, price £16., sashes, ornamental roof work,

vases, &c.; but the Prussian zinc-work was, as heretofore, more agreeable to me. The pretty—whatever a great English authority might think of the application of certain outlines and details—gilt and painted zinc Mauresque stall belonging to De Diebitsch, of Berlin, was full of apparently pretty things. The minor works in metal deserving mention consisted of wire seats and tables for use in gardens; square-bodied patent metal tubes; the imitation of bronze articles submitted by Dubois and Soulais, which were good in execution but selected with less taste than was desirable; and the electrotyped frames of the productions sent by the Austrian Imperial Printing Office.

The collections of useful and ornamental woods were numerous and magnificent; Tuscany, the Papal States, Spain, Venezuela, the United States, Sweden and Canada were among the minor exhibitors; Greece and Australia were among the largest. Among various treatments of wood were injection; anticorrosive coating; large panels rendered invariable for painting, coach-making, and furniture; and thin sawn wood (*feuilles de carton bois*); and Bavaria showed pine wood cut into 30 leaves in the inch, and mahogany cut into 11 leaves in the half inch. The number of exhibitors of wood carved as decoration or furniture was very considerable (214). England sent the greatest number 56, France 47, Holland 18, Denmark 15, Tuscany 15, Sardinia 14, Sweden 10, Norway 7, Prussia 7, Belgium 6, Bavaria 4, Switzerland 5, Spain 5, Austria 2, Baden 2. The carving bestowed upon these works was in general mechanically good; the taste of the ornament is all I shall have to mention after noticing the delicate workmanship of Knecht, Planson, Lagnier of Bordeaux, Guéret, Tweedy of Newcastle, and Wallis of Louth. The Canadian furniture, with much introduction of natural objects, was excellent; the rocking and Windsor chairs all sold from their cheapness: the very handsome wardrobe, by Roehr of Prague; the light and excellent chairs and furniture by Thonet, of Vienna; the ingenious expanding table by Boulfray; the Piedmontese billiard table, of a good sarcophagus design; and a chimney piece, by Fourdinois, costing 1920*l.* leave me to speak of the expensive bookcases, wardrobes, and sideboards, at prices varying from 800*l.* to 220*l.* Guala, of Turin, exhibited a good pattern of a carved roof, and handsome handrails; Ringuet le Prince, of New York, exhibited a sideboard in the Renaissance and Nature styles, which had much merit. Zora, of Turin, exhibited some of the best chairs, and other good furniture, with which might be ranked the Florentine and Sienese works. Cruchet's fine frontispiece of game, Jeanselme's bookcases, and Beaufil's, of Bordeaux, walnut bookcase, were probably those seen in 1851. The Emperor had purchased three cabinets or bookcases, and had certainly been well-advised. The English productions, scarcely visible under the galleries, the French Renaissance walnut-tree bookcase by Klein, the bed and glazed wardrobe, by Semey, the walnut bookcase of Wieber, Pitetti & Co., and the pear-tree escritoire by Gueret, who is also mentioned as a carver of small articles being imitations of natural objects, like Michaud and De Villeneuve, who send a frame exhibiting the best wood carving of the natural style in the French division, conclude my list of furniture.

The merit of design in piano-fortes rested with Hughes and Dunham, and Hopkinson, in the English division; and with Hornung and Muller, and Sörensen, of Copenhagen; they sent pretty cases, and the best as being the simplest: but the Swedish cases were trifling, like those from Hamburg, which is surprising.

The eighteen French, six English, and some Genevese manufacturers of paper-hangings, did not present anything which seemed peculiarly meritorious; for mere paper, Pirie, of Aberdeen, was considered by some French connoisseurs to show the pearl of the Exhibition. The specimens of parquetted floors, from all parts of the Continent, at about 10d. per foot superficial, were numerous as might be expected; it is hardly safe perhaps to judge from the examples exhibited, but those made of small bits split terribly, large bits stood better. The employment of caoutchouc, which was honored by a medal in 1851, has considerably increased. The taste displayed in picture frames and pretty ornaments, polished like jet, was of a high order, and creditable to the exhibitor Charles Goodyear.

Ivory, as a material for carving, appears to excite much attention in France—the large Renaissance casket, by Moreau, deserved much praise; as did the Renaissance casket, 9 by 4, in one piece, by Hebert, costing £40. In ivory turning no difficulties seem to exist; unless a mistake has been made, one cup was 6 ft. 7½ high, by 1 ft. 11½ dia. At least ninety-eight exhibitors in wood or ivory turning, and thirty-six others in fans, canes, sticks, parasols and umbrellas, sent their productions; among them, Collette was really conspicuous for the artistic merit of his sticks, finely carved and headed, at the price of £8. each. There was one remarkable exhibition of leather for decoration. Dulun asserts his enrichments to be 200 per cent. cheaper than wood; his hangings cost from 5s. 6d. to 12s. 6d. per yard, according to their richness; and chair coverings 4s. to 7s. each. An imitation of these hangings was charged at 1s. 6d. per yard. The imitations of wood in graining from Toronto were excellent, from France good, but both Moxon and Kershaw stood in the first rank for marbling and graining. Two French tradesmen observed that the work of the latter (grained and imitation inlaid doors) had no chance against so much that was real, and that the work of the former only required patience, which no Frenchman would condescend to give to the work. Two hydro-fuges, besides Claudel's coating for decoration and fresco painting, (apparently excellent); mastic hydraulique, Laurent-Machabée, 45, Rue de Vaugirard, (also apparently excellent,) and the process of Lebrun of Moissac, viz. "ineffacable coloring on stucco" were worthy of observation.

Seven French exhibitors supplied draining instruments and tools; seven others exhibited sawing and mortising machines. The great crane employed in the execution of the building, and two machines for breaking stones (*mortier concasseur*) for roadways, were simple and ingenious. The *psalizometer* was a sort of bevel equally useful in the *coupe des pierres*, or in the *coupe des draps*, for which last it was invented. The Austrian carpenter's bench was not a bad one; it would be worth the trouble of some society to have one in England for exhibition to the builders, the price of one highly finished being £1.; it was exhibited by Wertheim of Vienna, whose collection of tools was very complete and interesting; his catalogue should be obtained, for everything seemed of the most improved shape, and of good quality. The Prussian tools were far inferior in appearance. All the American moulding planes were sold; the profiles would have been good, if they had not been so very mean; this is a vice which seems prevalent in the modern buildings at Paris, I mean those erected since 1840, as they appear to be treated with less boldness of projection in details every year; this may account in some degree for the mania of polychromatization. The Canadian joiner's work looked at first sight fair, but on consideration it was machine-work to a considerable extent; and the material required to be cleaned, according to our notions, before the priming coat could be laid. The stuff seemed rasped, with little hairs of the grain of the wood standing out. An 1¼ four-panelled door with ogee moulding on one side, and a 5 inch two-faced bead ogee and square architrave with plinth, was marked at 15s., which has been called very cheap by some periodicals ignorant that a better article, under the same conditions, can be got here for the same price. The two best examples of French joinery were contributed in a window, by Bernard Hoen; the other in a ratchetted bookcase, made by the pupils of the Institut Imperial des Sourds-muets at Paris. Three French manufacturers had given their attention to scouring papers; granite, lava, emery, glass, flint, silica, and porcelain are the articles employed upon cloth or paper for polishing. As to large bellows, the only specimens I saw were made in England. The door-springs by Renaud of Paris (rue Pétrelle, 22) appeared to me to deserve the attention of our manufacturers; they occupied only the position and the usual appearance of the hinges. The merits of the different French systems of sashes and sash-fastenings, with sun shades, both internal and external, were beyond the passing observation of a stranger to their usual mode of manufacture.

There was considerable novelty and merit in the seven systems proposed for the construction of

wooden pulpit staircases or vices. They were on three principles, viz. with a solid newel, like the usual iron ones; with an open well-hole, the carriage being an iron plate; and with a continuous writhed string, which was much the most curious and the best looking; the steps had no risers shewn in the full size specimen exhibited. A double staircase was, if I remember rightly, also exhibited.

The prices of old bells recast, seemed to be 3½d. per lb., of new bells 14d., and 2d. additional for their mountings. There were several expensive contrivances of wheels and pinions for facilitating bell-ringing; but Besson's bells were very remarkable on several accounts. He claims the merits which follow on the adoption of the late improvements of the bell being turned in a lathe; on the power of lengthening or shortening the clapper, and on the details of hanging the bell; but the portion which most engaged my attention was the gudgeon and its seat. The seats, *coussinets articulés*, as he calls them, from £1. per pair upwards, are a variety of the knife-edge balance; the ease which they give to the ringer is such, that with one finger on a whipcord fastened to the wheel, he rings a bell of about 6 cwt.; and on asking him the number of men requisite to raise a bell of 15,000 lbs., he answered that two could do it if the bell were on these seats. Bells mended by Delcroix Mangin of Chalons-sur-Marne, and bells cast of steel at 8d. per lb., attracted much notice.

The employment of resin in making artificial stone; paper covered with composition to imitate slate, stone, &c.; and calico soaked in marine glue for roof covering—were French inventions; while asphalted millboards, said to be incombustible, and artificial slate for drawing board, were Austrian productions. Publicans' fittings and asphalted felt were only forwarded from England. A cap for smokey chimnies from Poitiers; thirteen French water-closets, which I did not examine, as they were in the division of Pharmacy and Surgery; three fire escapes, in the shape of ladders, and one in that of a box of carbonic acid gas; two street sweeping machines; as many chimney sweeping machines; and speaking tubes (which appeared to be a novelty and source of amusement to the French public,) complete the subjects of this class which I have to name.

There seems to be no good reason why all the architectural drawings, if not the models, should not have formed part of the Exposition des Beaux-Arts. The design of a college at some place in Canada, by Kivas Tully; Welland County Court House, by J. Gillespie; and the City Hall at Toronto, which give evidence of the existence of a really good school in Canada, were hardly distinguishable in the darkness under the galleries of the Exposition de l'Industrie. The architectural models were almost entirely from France and England. The former, from the stores of the Ministère de l'Agriculture, du Commerce et des Travaux Publics, contributed Pont Napoleon over the Seine at Berry, built by Couche, for a railway as well as for carriages and passengers; Pont d'Arcole over the Seine at Paris, built by Oudry; Viaduct Bridge at Dinan, over the Rance, designed by Reynard, built by Mequet and de Gayffier; Railway Viaduct Bridge at Tarascon, over the Rhone, built by Talabot; another at Arles, over the Durance, built by Talabot; another over the Bouzanne, built by Borrel; another at Asnières, over the Seine, built by Flachat, and the Aqueduct of Roquefavour over the Are, built by Montricher. Private exhibitors contributed the model of the metal Cupola of the Observatory at Paris, as in 1851; the Viaduct of five arches, each 131 ft. 3 in. span over the Rhone at Lyons; Marseilles and Toul Cathedrals; the Church of S. Jean des Vignes at Soissons; and Polonceau's Roof over the Station at Versailles, of the Rive Gauche Railway. From Switzerland there were some pretty models of chalets. In the English department there were models of the New Market at Holloway, by Bunning; the Victoria Bridge (stone) over the Clyde, at Glasgow, five arches, 1851-54, by Walker and Burgess; the Suspension Aqueduct at Stanley, near Wakefield, and a Bridge at Leeds, by Messrs. Leather; the moveable Viaduct at Ulverstone, and a Bridge by Brunlees; and Mr. Lassell's iron revolving Observatory Dome, at Bradstones, near Liverpool. India sent the model of the Roof-

muttee Mosque, at Ahmedabad (1499 A.D.) From Canada there were several models, viz. the Brock Monument, on Queenstown Heights, Western Canada, 185 feet high, which is a composite column, by William Thomas, architect, at Toronto; the Court House at Montreal; and the celebrated Victoria Box Bridge across the river St. Lawrence, at Toronto. Besides these there were several specimens of ingenuity—such as an idea of ventilation by means of ceilings decorated with deep girders; a balustrade and stirrup for an iron bridge; a design for a railway station roof, made with trellised laths caught in by rods everywhere, apparently good for iron construction; and the fine model of the roofs, 60 ft. square, over the workshops of Nepveu and Co., at Clichy. This model, presented to the Conservatoire des Arts et Métiers, where it should be studied by travellers, was the only example in the Exhibition of the modern style of framing roofs as practised usually in England.

Several self-subsistent pieces were in the collection: it is to be regretted that they were so deficient in success. Among the best was one altar and doorway, by Gates and George, of Caen; a fountain aviary, by Tahan; a surprising open oak-work shrine, costing 200*l.*, by Dumon, of Bruges, in a German Gothic style; and a rich German Gothic, but badly put together oak altar, by Goyer Frères, of Louvain, at the same price. The frightful pulpit (oak), labelled as executed under the superintendence of the Abbé Choyer, Directeur d'un Etablissement de Decoration Religieux, at Angers, accompanied by an altar nearly as bad, were very inferior to the other French altars; the pulpit and canopy with winding stairs poorly executed and not in the best possible taste, costing 520*l.*, by Veneman, of Bois-le-Duc; or the oak altar, second rate, by Prang, of Munster, price 140*l.*; all which were eclipsed by the very correctly detailed altar piece of copper and silver gilt, designed by Viollet le Duc, I think for Bachelet. The terra cotta altar piece for the church of Maison-Rouge (Seine et Marne), by Debay and Co., would be placed by me in the first rank of those exhibited.

A complete copy of the Bauzeitung, I did observe, but there was no English journal relating to our profession, no Civil Engineer, no Builder, not even an Art Journal. One architectural publisher at Berlin, sent upwards of fifty works, but no other exhibitor emulated him: I presume these books were only admitted as specimens of typography; they included the Prussian Government work on decoration, and Salzenberg's Agia Sofia. Sixty-four French designers for manufactures were allowed to exhibit their skill, and they furnished one of the most interesting of the galleries, in one of the most conspicuous places; four Belgian, and one English decorative artists were lost among the goods in the back grounds of their respective countries. Such is the difference to be expected between the two leading countries which manufacture decoration; in one the Empress has the *designs* of her shawls and dresses submitted for approval; and the Emperor purchases the only good thing, but it *was* good, in a poorly furnished stall; in the other, the decorative arts are so miserably represented by a government department, that it was painful to see how ill-judged an attempt had been made.

This was one of the quinquennial Exhibitions at Paris; as the Exposition des Beaux Arts, due in 1854, was postponed to the present occasion. While the other countries of the world only sent forty-five subjects (and of these only eleven were executed designs), France sent forty-three archæological subjects, twenty-seven restorations, nine projects, and four executed designs, in all eighty-three works; and England sent ten archæological subjects, eleven restorations, twenty-four projects, and fifty-two executed designs, in all ninety-seven subjects. I must add to the French list twenty-six sets of the Grands Prix, making 109 subjects, and giving a total of 251 in the Exposition, where our countrymen held the first rank as designers, practitioners, and artists in water colours.

In the consideration of the awards of the juries, we must recollect that great self-gratulation was originally expressed by the officials at the working of the French system as to awards, which

system "*appelle à les recevoir les contre-maitres et les ouvriers.*" I shall be glad to see if that system works well as regards architecture, and shall be joyfully surprised to see if any of our English architects have mentioned conscientiously the *contre-maitres* to whom they have been indebted for such pretty pictures as those sent to Paris on this occasion. Not being an exhibitor myself, I can regret that no academical designs of the present time were sent from England; there are enough in London, to set with humble confidence beside the twenty-six French Grands Prix: but, when I asked in this room the Government Committee whether such designs would be received, and recommended that if they were not, a circular should be addressed to certain individuals, you will recollect that I was lectured for the presumption of the advice. The result has been, that the Committee did send the circular, but did not compliment the proposer of it with a copy; and the French themselves want to know, why the representatives of grand art in English architecture have not exhibited? Those who know anything of the working of an international jury, will comprehend that the disposal of rewards is not likely to be satisfactory to the English manufacturers and artists. Not satisfactory to the manufacturers, because they rarely condescend to the trickery of putting forward their goods at feigned prices; because they trust, without puffing, to the reputation of their firms and to the connection which belongs to it; and because, when they do see something better than their own, they confess the fact with a readiness which does England no little harm upon the Continent, although it is much to their credit as honest men. Not satisfactory to the artists, for reasons common to them and to the manufacturers. Among both classes of labourers abroad, those who deserve well of their country, receive decorations, which form a visible distinction between vulgar capital and talented industry (in one or two countries these distinctions cannot be conferred by the Government of its own accord); and foreigners are not aware that Englishmen cannot obtain permission to wear even the decorations received from other countries. So that when our artists and manufacturers visit the Continent, especially upon an occasion like the Exposition, their foreign rivals glance at the breast of the Englishman to learn at once the mental standing of their guest. No cross, no ribbon, no medal offers itself to view, and they naturally say to themselves, this may be a good man and a rich man, but he has no talent or he would have been decorated like ourselves. I would be thankful to believe, that Sir Charles Barry, or Professors Cockerell and Donaldson, as an acknowledgement of their art, ever wore the gold medal of this Institute abroad, even on special occasions. I believe there are only five Englishmen who at present can show a royal medal for art. All the commendations which you have heard, may not be confirmed by those of the juries; but I expect, that the international juries will bestow their medals for extraordinary cheapness, for extreme beauty of design, for soi-disant extraordinary inventions, and for previously achieved distinction: in which case, we shall probably see, that upon sufficient explanation from their friends, those of our countrymen who obtain the chief honors, will be those who have been knighted at the cost of £300. to themselves, after their worldly success would enable them to disregard so expensive a mark (of royal—not national—approbation,) which is hardly understood at all abroad as being far more than equivalent to the cross of an order, and certainly does not always fall on the right shoulders.

It may be asked, what good has been derived by our profession from these exhibitions? Whatever may be the tenor of the awards of the juries, I believe that two things are clear results. Our employers have had the opportunity of seeing in that France, which is supposed to be their leader in fashionable knowledge, that architecture is not a trade, but one of the beaux arts; and ourselves have had the opportunity of making such acquaintance with the French architecture of the present day, as to demolish much of the tendency to self-abasement before it, which has been too common in this Institute.

AN ABRIDGMENT OF M. LANCE'S ESSAY, ENTITLED "ON A DIPLOMA IN ARCHITECTURE," WITH REMARKS AND SUGGESTIONS.

By John W. Papworth, Fellow.

Read at the Ordinary General Meeting of the Royal Institute of British Architects, November 19th, 1855.

I may be allowed to state to the gentlemen who were not present at the last meeting, that proposing to read it to the Institute, I had the pleasure of presenting "avec l'hommage respectueux" of the Author, an Essay by M. Adolphe Lance, Architecte du Gouvernement, at Paris, entitled "Du Diplome d'Architecte:" and that after the address of Mr. Tite, the President at that meeting, the Honorary Secretaries were so good as to suggest this opportunity for offering to your attention the history of what has been done in France with regard to the important question of which Mr. Tite urged the consideration, viz., the institution of an examination, and of its necessary result, a diploma.

I have endeavoured to give the passages, which are extracted from M. Lance's Essay, as nearly as possible in his own words, and have therefore only to add, that the remarks in italics are either very much abridged from the Essay by M. Lance, or are suggestions for which I alone am responsible.

Legislation on public instruction has undergone, in the last few years, very serious modifications, which seem to have attracted general attention to the question of education as a whole, and also to the questions of organisation which relate to it *in France and in England.* This movement is especially observable in relation to the profession of the Architect *in both countries.* Important reforms in the laws, or in the customs which regulate that profession, had been previously brought forward, *and in England had been partly adopted.* Their object *in France* was to give to the public more positive guarantees of the skill and experience of the artists whose competition that public demands: *and in England, as* well as in France, to give to the body of Architects more unity, more strength, more cohesion, and a more defined, and consequently, more respectable position; so as to ameliorate their worldly condition as managers of a very considerable branch of industry, and thereby to open to Architecture, as an Art and a Science, a more open path in which it might proceed with more consistency, and with a firmer and more assured stride. Such, we say, was the object intended; this is not the time to discuss if the means then sought were those to lead with the greatest certainty to it *in France; it cannot be denied that the establishment of this Institute has done much in this country towards attaining it.*

The notions which were at one time subjected *in France* to searching discussions, and whose realization was pursued in vain with unusual perseverance, though never completely abandoned, appeared for a time to slumber, so much were they laid aside for others causing more general anxiety. At present, if we are not mistaken, these ideas are aroused, and the minds of our colleagues return, with marked predilection, to the study of these difficult questions. It is the general opinion that "something is to be done," and the moment seems favourable for agitating afresh these problems, and for opening the way to a definite solution, whatever that may be.

The profession of Architecture is absolutely free. Whosoever likes may practise; whosoever chooses may call himself an Architect; no one is compelled, in order to obtain the title, to prove before competent authorities that he possesses any of the knowledge requisite for the discharge of his duties.

He is an architect by the same right that another is a manufacturer, a dealer, a speculator in any enterprise; the law supposes that clients find either in private connections, in public notoriety, or in their own discernment, sufficient guides for their appreciation of the skill of those men who represent themselves Architects, and offer to direct the construction of works. An observation in the Dictionnaire d'Architecture, by Roland le Virloys, published at Paris in 1770, is precisely applicable at the present time: "As soon as a man knows a little of drawing, he sets himself up as an Architect. Draughtsmen, decorators, and others of that description, are not the only ones who are so bold. If a bricklayer has built two or three houses, he calls himself an Architect; and forthwith gives plans and designs to all who are kind enough to listen to him, intimating that they will save the small but useful expenditure of the fee due to an Architect; while the real object is only to withdraw from subordination, and exercise the tricks to which the building trades are but too much addicted." *It must be recollected that this is the language of French architects; the English architects have other grounds of complaint; and that the English builders profess to have grounds of counter accusation.*

Is this legal liberty of the profession a novelty? Is it peculiar to our country? Certainly not: for the quotation just given is dated, as before mentioned, in the year 1770; that is to say, at a period when the restrictive system of sworn guilds and corporate freedoms was in full vigour *in France, and apprenticeships in England*, and we know that it was not applied to architects. (*I may observe that M. Lance has not admitted the tradition of the Freemasons into his Essay;*) *but he adds that*, in fact the regulations very anciently imposed upon master builders, and the more special and later institution (*in* 1574) of sworn surveyors, cannot be considered as relating to architects.

M. Gourlier, in a report which we shall have occasion to cite presently, justly observes, "it does not appear that any measure was ever adopted to investigate the claims, more or less founded, which individuals might have to call themselves architects, and exercise their profession. Architecture properly so called, was in this respect considered as a 'free art,' and it was permissible to any one to exercise it at his own proper risk and peril, as also at the risk and peril of those whose confidence he obtained."

Evidently unaware of the Prussian system which Mr. Tite laid before us at our last meeting, M. Lance continues to say that if we examine foreign legislation, it does not appear that it can give any answer other than that from our own country. Everywhere, with a single exception, it is "liberty." At least, the Société Centrale des Architectes, which had maturely studied this interesting question, cites only one country in which the exercise of the profession of architecture is subjected to conditions which are intended to prove the skill of the artists who dedicate themselves to it: that country is Spain; and the date of the institution is recent. The first statutes relative to architects were presented in the last century to King Ferdinand VI. by a Frenchman named Hérard, Member of the Academy of Madrid; and they received the royal sanction. They were modified and renewed 29th July, 1801, by King Charles IV, on the proposition of Don Pedro de Cevallos and Isidore Bosart, also members of that Academy.

From that time the following custom has existed:—No person may call himself an architect, or practise the profession, if he is not affiliated and approved by the Royal Academy of S. Fernando, and if he has not received a diploma from it. This diploma is obtained under the following conditons:—

Production of a document from some architect affiliated to the Academy, certifying that the candidate has worked under him, and is conversant with the practice of building.

Deposit at the Academy of a design, with its working details, an explanation of the proposed mode of construction, and a specification (the subject is chosen by the candidate).

Actual manipulation of a tinted sketch, &c.

Public examination in the subsequent week, for two or three hours, on practical geometry, the theory and the practice of architecture.

Foreigners are admitted under the same conditions. When this diploma has been obtained, the artist may practise at any place in the dominions of his Catholic Majesty. Private persons need not employ an architect affiliated to the Academy, but if they do not, they have no right to enforce responsibility at law. Only architects affiliated to the Academy can be employed by the Crown.

The two systems are thus brought face to face:—the rule of unlimited liberty, without any guarantee of capacity;—the rule of freedom limited by the necessity of satisfying the conditions of skill which a public authority is charged to obtain. Which of these two rules should be preferred? Which of them presents the most security to the public? Which assures the highest consideration to the artist? Which promises the greatest development of the art? Such are the questions which we want to examine and which it is opportune now to agitate. Before entering into these questions, it will be well, and we believe, not without interest, to consider the very anxious, very elaborate, and very noteworthy enquiries which the Société Centrale des Architectes at Paris has dedicated to this subject. A simple analysis, as succinct as possible, is all we shall ask permission to place before you; *as the two countries differ much in their political institutions, so several of the questions discussed by that Société are peculiar to France, and twenty-four pages of the Essay* by M. Lance, must be condensed into as many paragraphs.

Struck with the isolation in which their fellow-labourers were living, and with the danger resulting from that isolation to the profession, some of the French architects proposed in 1840 the foundation of some central body.

At that time M. Gourlier gave his attention to the question of a diploma, which he treated in an excellent report presented on behalf of a committee to the future founders of the Société Centrale. It might even be said that the study of this subject was one of the objects of the institution. . . . . The report shows that the complaints of the architects are long standing ones. It does not ask for the restoration of guilds and corporate privileges, the revival of the defunct *Academie*, or of the corps of sworn surveyors; but it points out the existence of privileged professions, privileged, that is to say, for the public good; such as barristers, solicitors, proctors, physicians, surgeons, apothecaries, &c. The report asks if there is not an evident analogy between those professions and that of architecture, and whether there is not, consequently, a good ground for subjecting the one, like the others, to certain conditions of capacity; that is say, to render imperative the possession of a diploma which shall be a mark of that capacity.

The report answers in the affirmative; but as to the application of the principle, it glides away into observations on that topic which are very general, but perhaps wiser ones, and more in harmony with French legislation than those which were put forward at a later time. This report supposed the Ecole d'Architecture, with an altered system of education, to be made a special college, like those of the physicians and the surgeons *in England and in France*: but making it the duty of the Ecole to give instruction, as well as to see that it was acquired; to examine the candidates, as well as to deliver the diploma; *it also insisted that even a formal attendance in the Ecole should be required of each candidate who had not been educated therein. . . . . In* 1843, *the Société was chartered.* . . . . In 1844, the Société Académique of Lyons requested the opinion of the Société Centrale as to a statement prepared for presentation to the Minister of the Interior upon the faults which existed in the organization of the profession of architecture, and on the necessary remedies. . . . .

The subject was referred to a Committee, and in March and June 1845, *Messrs. Blouet, Caristie,*

Debret, Gilbert, Sen., Gourlier, Jay, Lebas, Ch. Rohaut, and Leon Vaudoyer, reported unanimously in favour of the establishment of a diploma; and by a majority, that it should be imperatively required from all architects; and they also pointed out the composition of the Board of Examiners; the cases in which the diploma should be granted without examination; &c. The Council of the Société took that report into consideration, and in June 1845, drew up a new and excellent work, entitled "Results of the Deliberations of the Council," which was distributed to the members previously to the first meeting held on the 17th June. Both in the Committee and in the Council, there were some objections to the principle of the creation of a diploma: these objections were founded upon reasons that really did not want weight: a diploma seemed to compromise the freedom of art. Another ground was the difficulty in appreciating artistic acquirements; and fears were expressed lest, in consequence of that very difficulty, scientific acquirements should obtain an invidious preponderance in the examinations. This reasoning failed.

I must here point out that the reason why success did not ultimately attend the efforts of the Société towards the establishment of a diploma, was connected with the second determination to which the Committee gave utterance, viz., that it "should be imperatively required from all architects;" a view which was finally adopted by the Société, and which therefore required the assistance of the Government.

Upon the question of the imperative or voluntary character of the diploma, some persons alleged in favour of the more rigorous view, that not to require the diploma from every man before he was allowed to practise, was to fail in the object proposed: that such a step would allow the public to confound ignorant practitioners who usurped the title of architect, with approved artists who merited the rank: . . . . and that besides, if the diploma only authorized the possessor to adopt the title, it was not indispensable to any one in actual practice.

Others replied in favour of the voluntary system, that the profession of architecture, both as an art and as a science, had always been, and ought always to be, open to every one; that it was puerile to make the title essential, if the functions might be discharged by anybody; that in asking too much, there was the risk of obtaining nothing; and finally, that it would be sufficient to stipulate that the architects in the Civil Service must be possessed of a diploma. This reasoning prevailed, and the Council, differing with its Committee, adopted the idea of a voluntary examination; . . . . . *and also negatived suggestions for the creation of a secondary diploma for assistants and clerks of the works; as well for fixing an age which must have been attained by the candidates.* The Council, however, adopted the suggestions of its Committee as to the nature and amount of knowledge to be required; as to the composition of the Board of Examiners; and as to the classes of exemptions. . . . . *It also called attention to the reforms that were desirable in the system of education conducted under the auspices of the Academy, in the section of architecture at the Ecole des Beaux Arts; and noticed the necessity of improvement in the position of the Government architects.* . . . . *The memoir of the Council concluded by adopting as a standard of merit the knowledge to be acquired by earnest study during a whole year in the first class of the* Ecole des Beaux Arts. . . . . .

These results of the deliberations of the Council, communicated, as we have said, to the Société at its meeting on the 17th June, 1845, were remitted to Sub-Committees, one of which carried a proposal that before a general discussion the results should be submitted to a fresh Committee chosen by the Société: the new Committee consisted of Messrs. de Joly, Armand, Chatillon, Chargrasse, Girard, Nourrigat, Quicherat, Vigoureux, Sen. and Gounod, and it finished on 25th February, 1846, its labours, which were laid before the members at their own homes. The new report was perhaps less methodical than that of the Council, but very detailed, and full of interesting and carefully studied facts, which rendered it well worthy of the attention which it received. . . . . It asks, after some preliminary

remarks, if the very existence of the Société Centrale did not render the creation of the diploma useless, and if the Société did not sufficiently distinguish, by its elections, the architects who really deserved the title. The report had no difficulty in giving an answer in the negative; and we are surprised that such questions were even put. Whatever opinions may be expressed upon the subject of the diploma, it is impossible to confound the public and official character which, if given by authority, the diploma would confer upon its bearer, with the truly honorable notice and the favorable inferences which a society like the Société Centrale, (*or this Institute,*) unshackled but possessing no official authority, can convey in the elections of its members. The new Committee did not separate the character of the proposed diploma from the relation that it might have with the Body, which ought (*in the opinion of the French architects as well as in my own*) to be completely distinct from it; as distinct for example, to continue our comparisons with analogous professions, as *the Church from the Universities; the Geological Society from the School of Practical Geology. . . . . There were other difficulties into which we need not examine, as they were chiefly connected with the Ecole des Beaux Arts.* The Report of the new Committee contained the following recommendations, viz. the creation of the diploma as a matter of necessity; its obligatory character; no dispensation from examination in any case; transitory measures in favour of positions already acquired; the age of thirty years (which is that absolutely of admission to the Société Centrale, 28 generally in the class of Fellows, to this Institute) and the delivery of the diploma by the offices of a Cabinet Minister. . . .

It will be seen that as the matter progressed, the regulations became more severe. . . . Like the Council, the Committee refused, as we think with great wisdom, to enter into any discussion upon details; such discussion would be fruitless, while principles are not decided. . . . . Before taking it to the general meeting, the report of the new Committee was discussed afresh by the Council, and this revision gave rise to a remarkable vote, which preceding votes would not have led us to expect, and which, it might be easily foreseen, would not be approved by the Body. The Council turned round; abandoned its first opinion, and negatived the principle of a diploma. . . . . The discussion of the last report took place at the general meeting of the 11th June, 1846; it was continued on the 24th June and 1st July. The Société did not consider itself prepared to discuss the questions relative to the formation of a Board of Examiners, and to the system of education; these were referred back to the Council; and it was not until the 28th October, 1846, that the Société was called upon to decide on these points as treated in a final report of the Council. It then

Resolved,—

That a diploma or certificate of capacity should be instituted, which should be indispensable in future before any person could legally take the title of architect, and practise as such either for individuals, or for Government, in any part of the country.

That the diploma should be delivered immediately and without examination to all architects actually engaged, and practising honourably; so that existing interests and already acquired positions should be respected.

That a programme should be adopted of the theoretical and practical acquirements which should in future be required, without any exception, for the delivery of the diploma after examinations and competitions.

That a Board of Examiners should be appointed, consisting of Architects.

That the Ecole des Beaux Arts should be remodelled.

That the Civil Service should be so far reorganized as to assure better treatment to architects who entered into the service of the public. . . . .

Here ended what may be called the deliberative phase of the subject: it lasted for six years:

the Société had arranged and decided upon its intentions, and had only to push them to realisation. . . . .

It is only necessary to add that the Société circulated in influential quarters an essay on its wishes, accompanied by the programme; that in 1847, *the Société learnt that the previous Minister of Public Works had spoken favorably of the Société, that the acting Minister had promised his attention to the matter, and that a decree was all but signed when the events of February occurred.* . . . .

The Council, however, applied to the Provisional Government, and reported an interview to the Société on the 6th March, 1848; *whereupon another Committee was appointed to produce a new edition of the Essay just mentioned. Messrs. Henri Labrouste, Brunet-Debaines (replaced by Haron-Romain), Constant-Dufeux, Gounod, Jay, Adolphe Lance, Lepreux, Lucas, Tougard, and Gourlier, accordingly commenced operations, but the report submitted* 10*th November,* 1848, *contained only four articles; viz. the alteration of the Ecole; the institution of an imperative diploma; its delivery to practising architects; and the reform of the public service.* . . . . *It would be painful to enter into a statement of the new discussions which arose in the Council, and at the meetings of the Société on* 23*d and* 30*th November, and on* 7*th December,* 1848, *which resulted in the adoption of the new Essay, with the exception of the passages as to the public service, and the Ecole; a vote which appears to have put an end for the present to the whole matter.*

The lesson, which this history, as given by M. Lance, is calculated to afford to ourselves, is one of the highest importance. The Société Centrale des Architectes, having become very exacting in its requirements, was not content to put its own shoulders to the wheel, and look after the interests of the profession, as a profession, so far as its constitution allowed it; but, perhaps involuntarily, perhaps obliged by the peculiar institutions and customs of France, it was led to interfere with the Academie des Beaux Arts and its School, to invoke the aid of the Government, and to enter into arrangements between the Public Service and its architectural officers.

There can be no wonder that having such different objects combined in one project, the Société has not yet gathered any fruit from its exertions.

The questions which arose naturally out of the subject, and which we have seen successively discussed by the Council and by the Society, were the following: we give them now, collectively, *so as to concentrate attention.*

1. Is a diploma for architecture necessary?
2. Shall the diploma be the result of a voluntary or of an imperative examination?
3. What body shall test the fitness of candidates?
4. What body shall give the diploma?
5. Is it desirable to fix any limit of age in candidates?
6. Shall the examination be open to all candidates?
7. Shall any candidates be exempt from examination?
8. What measures shall be taken to facilitate the adoption of the diploma?
9. What acquirements shall be tested in the examinations?

Does any one suppose that the diploma would take away from the profession of architecture its liberal character, and from the artist himself any portion of his independence? Can the medical man in that respect envy the architect? We think not. But it may be said that architecture should not be compared to medicine, but to its sister arts, painting and sculpture. We think otherwise. Architecture truly is one of the imaginative arts, but it is at the same time a positive science. The inspirations of a happy genius are not enough for it; it requires an amount of knowledge which the imagination cannot give. In practice the architect cannot be compared to the artist, who only

requires a canvass or a block of marble to show all that he can do; the architect in some respects is more than that; he is an officer in command of a regiment that does not know the precise result intended by its manœuvres; he is an agent who disposes, it may be said, arbitrarily of the fortune of his client; he is almost a magistrate compelled to decide upon separate and generally conflicting interests, often of very considerable importance.

Whatever may be said or done, the man, whether he be an artist or not, who is likely to be invested with so much power, and whose position obliges him to accept such responsibility, cannot pretend legitimately to the independent freedom of artists in other walks, who execute their works with their own hands and at their own risk, without having to give any account of their management. This is so true, that while the painter and the sculptor can give with impunity proofs of their unfitness, the law has a hold, and a tolerably firm one, upon the careless or unskilful, or unfortunate architect. . . . .

We say that a diploma would have the advantage of adding to the consideration which the profession of architecture more or less enjoys; and indeed it is easily conceivable that in making a preliminary demand upon those who wish to exercise that profession for proof of some amount of acquired knowledge, the presumption of capacity resulting therefrom would place the body of diplomatized architects in a new position. . . . . Without doubt this diploma will not make a *William of Wykeham* nor a *Christopher Wren*, any more than a call to the Bar makes a *Cicero* or a *Burke:* but as it would represent a minimum of the knowledge indispensable to the public, it would be at one and the same time a recommendation to its possessor, and a guarantee to the public.

We would say further to the advocates for absolute liberty in the exercise of the profession of architecture,—suppose for a moment that medicine was to become free from all obligation of this sort; that is to say, accessible, as heretofore, to horse-doctors, to farriers, to vendors of nostrums, to barber-surgeons, to all such adventurers, and to any one else who had no other skill than that of boldness and quackery—suppose that; and imagine the condition of suffering humanity under the scourge of such disguised assassins; disputing greedily for the bed's-head of the patient, purging here, bleeding there, amputating one extremity, trephining another; in short, having the right to kill anybody under authority of a licence granted for two pounds per annum.

Yet this is very nearly the situation in which we are placed by the liberty which we enjoy: "*an abandonment to destruction rather, in which we are left to perish.*" There is this difference, it is true; the parasites of architecture are less dangerous than those just mentioned, because they attack the purse more than the body of our fellow-citizens; but society owes protection equally to the property as to the person. . . . .

And, moreover, whatever may be said, the public ought not to be left to assure itself beforehand as to the capacity of architects; the public cannot possibly be a good judge of merits which it cannot itself test. We may even say that the public should in such cases be treated as a minor, and that some authority, some guardian, should exist, not to hinder it from speculating foolishly if it likes, but to give it the means of saving property if it chooses. . . . .

We have spoken also of the Law; and indeed there is a relation between that profession and architecture which it is impossible to overlook, because, like the lawyers, we are employed to defend the interests of others. Still there is this difference between an advocate and an architect; the first, properly speaking, is only a counsellor, who in disputes between parties has only a deliberative voice, while the architect's is administrative. In other words, the advocate may plead more or less forcibly the cause of his client, may even be so unfortunate as to compromise the success which he seeks, but sees above him competent and enlightened judges seated to perform justice, and to give a chance

that the truth may appear in spite of the ignorance or carelessness of the lawyer, who may risk the interests of his client, but cannot always sacrifice them. Our part in business has a very different importance. The architect is not merely the advocate charged to enlighten a tribunal which has to pronounce judgment; he is more, for he is a judge, who can take no opinion but his own, *and whose decisions are not open to public inspection:* now if this judge be unskilful or dishonest, we guess, and it may be boldly said, we know the abuses and dirty actions which may result from this uncontrollable power, if it is exercised without conscience and without talent. Nevertheless, incredible as it may seem, the law requires that the mere advocate shall have given proof of capacity and experience, while it demands nothing, absolutely nothing, of that arbitrator, referee, umpire, who, under cover of that quality, can commit the grossest errors, nay, even crimes, at the expense of the parties who have honoured him with their confidence.

There is evidently a gross anomaly here which it is of the highest importance to ourselves to remove: *the establishment of the Institute, and its severity in carrying out its law of expulsion, are guarantee to the public of the unimpeachable honesty of its members; but where is the guarantee of their possessing that amount of skill which only can elevate the architect above the self-assumption of uneducated persons.*

The remainder of M. Lance's essay relates to the position of affairs in France so much, as to render it less interesting than I feel certain the preceding portion has proved.

This is, perhaps, the proper occasion for submitting my own views as to the practical solution of the question in England.

The necessity for a diploma is apparent from the fact that the junior branches of the profession have for many years been seeking it, as being desirable for themselves and perfectly innocuous to the elder architects. Professor Cockerell will of course support with alacrity any matured plan for securing better public appreciation of the art and its professors. Professor Donaldson has announced in this room, as a matter for self-gratulation to us, the establishment of certificates in two colleges. Sir Robert Smirke, Sir Charles Barry, and Mr. Hardwick, cannot be supposed indifferent to the wishes of their professional brethren Mr. Sydney Smirke and Mr. Gilbert Scott equally are anxious for the improvement of our position. Mr. Tite you have already heard; and in fact the only opposition which the measure of establishing a diploma can encounter would arise from those who feel some hesitation as to the possibility of their deserving it.

The diploma cannot be the result of an imperative examination, without an Act of Parliament to that effect; and the Legislature will of course refuse such an Act until the profession has shown that the diploma is feasible and in operation. The Institute should never require the diploma of any candidate for election into its own body. The examination would be most honourable as a voluntary one.

The examining body should at first be composed of those who occupy a high station with the profession and with the public,—hereafter those who take the highest honors would replace them as occasion should demand.

The question of the body which should grant the diploma is a difficulty in the eyes of some. There have been three competing opinions as to the preference to be given to the Universities, the Examiners, or the Institute. The Universities might follow our example if they found it well so to do; the Examiners would be subordinate to ourselves; and therefore the Institute, especially if it should obtain an amended charter, seems to be the body which, as professional men, we should prefer.

It is hardly less desirable to fix any limit of age to candidates, than to close the examination-room

against any candidate, whatever may be his position in society; if he be found fit to practise as an architect, that qualification should entitle him to the diploma.

The exemption of any candidate from examination would be a fatal error; nor should any candidate be allowed to pass upon a lower standard than that fixed for all comers.

To facilitate the adoption of the diploma, I imagine the adoption of a chairman, who should be, if possible, a President of this body. I imagine that the three Professors would not refuse to accept the diploma at his hands; and then we have a Board who could give to all qualified persons, who have practised legitimately during the last few years as architects, the diploma of Master in Architecture, and to those who have been so engaged for a short time only, the diploma of Bachelor. I suppose that some would be found to deserve the most honourable degree of Doctor in Architecture.

It must be evident that the severity of examination for these degrees must be relaxed for the first three years; there are men of established repute whose neglect of the diploma might be hurtful at first to its existence, and who might not choose to do more than present themselves personally to claim it; and this class must be consulted in order to facilitate the transition.

Then, when the examinations are fixed, the Board would only have in the first year to verify the position held by the candidate, and his power of making before them a tinted sketch and an outline of detail, in order to hand to him their certificate of the ordinary degree of Master or Bachelor, as the case may be. While if the candidate apply for a higher degree than that which he would ordinarily claim, we should all rejoice at his being found worthy of it.

At the end of three years the examinations should be stricter, and at the end of five years they should have attained the ultimatum, for a time, of their severity; then the profession would be in such a position as it cannot at present hold; and might reasonably hope to procure the adoption by the Legislature of a Bill against quack-architects.

I shall conclude by observing that I sincerely hope the examinations will be public, i.e. will be held in the presence of any graduates who choose to attend them; and that the examiners will avoid the fault of the Continental systems, and not ask questions upon formulæ and facts to test the memory of a candidate crammed for the occasion, and ready to forget all on the next day,—but put such questions as a candidate may be expected to answer, by referring to works in the library of the Institute. It is not what a man can recollect, but his knowledge of how to use and where to find information, which is the great secret of the skill of the architect as a scientific man, and of his knowledge as an archæologist. His taste cannot even be a question for the examiners; but readiness with the chalk, the brush and the pencil are, I venture to presume, indispensable to the man who lays claim to the authorised title, the honourable title, of architect.

A DISCUSSION AT THE ROYAL INSTITUTE OF BRITISH ARCHITECTS,

November 19, 1855,

On Subjects connected with the Address delivered at the Opening Meeting, by Mr. Tite, V.P.

Mr. J. W. Papworth, Fellow, having read an abridged translation of M. Lance's Essay "On a Diploma in Architecture," with remarks and suggestions,

Mr. H. H. Burnell, Associate, proceeded to lay before the meeting the results of his own experience during his studies in Paris, and the following scheme of instruction and examination to which competitors for the architectural prizes are subjected in that metropolis.

Examination of Candidates for admission as Students of Architecture at the Ecole Imperiale des Beaux-Arts, Paris.

Before a candidate can present himself for examination he must become the pupil of some known architect, cause his name to be inscribed in the book of the Ecole des Beaux-Arts, and present the certificate of his birth (acte de naissance) in order to prove his age. A student is generally from one to two years in the "atelier" of his professor before presenting himself for examination.

1st Examination—Arithmetic; Geometry; Algebra. (*Verbal Examination.*)

2nd Examination—Descriptive Geometry. (*Verbal Examination*); and a difficult Geometrical Exercise, called "Une Epure;" to be done in twelve hours.

3rd Examination—A Sketch* of a Building, consisting of Plan, Elevation, and Section, from a given Particular; to be done in twelve hours.

Should the Student succeed in passing the three Examinations, he is admitted as a Student of the 2nd Class, and may take part in the following competitions, which are thus divided:—

Mathematics—

Statics; Conic Sections, &c.; Land Surveying; Mensuration. (*Verbal Examination.*)

Trigonometry; Resolution of the Triangle, &c. (*Examination by Papers.*)

These examinations take place every year. The rewards are medals and certificates of merit. The student must gain a medal and a certificate of merit to be admitted to the 1st Class.

Perspective—

An exercise to be done in twelve hours, from a given particular.

This competition takes place once a year. The rewards are medals and certificates of merit. The student must gain at least a certificate of merit to enter the 1st Class.

Construction—

In Stone; in Wood (comprising Roofs, Girders, &c.); in Iron; General Construction.

Three months are allowed for each of these competitions. Students are required to make the sketch from a given particular in twelve hours, and the finished drawings in three months. The rewards are medals and certificates of merit. A medal must be gained in each competition to enter the 1st Class.

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* All Sketches are made "en Loge" within the walls of the "Ecole des Beaux-Arts;" the Finished Drawings (except for the "Grand Prix") are made under the superintendence, and in the Atelier of the Student's Professor. The Exhibitions of Sketches and Finished Drawings are open to the Public.

Architecture—

Every two months a competition takes place. A sketch is required to be made in twelve hours (according to a given programme), and the finished drawings in two months. There is also a competition every two months for sketches; they are made in twelve hours, according to a given particular. The rewards are certificates of merit, of which the student must gain three to be admitted to the 1st Class.

When the before-named competitions and examinations have been passed, and the required number of medals and certificates gained, the Student is declared to be of the 1st Class, and may take part in the following proceedings till he attains the age of thirty years.

First Class.

A competition takes place every two months. The sketch is made in twelve hours, and the finished drawings in two months, from a given particular.

There is also a competition for sketches (*only*) every two months; they are made in twelve hours, according to given particulars.

The rewards are medals, which are distributed every year at the General Meeting at the Ecole des Beaux-Arts, but the judgment is given immediately after each exhibition.

The jury that adjudge these various premiums elect their own members, but the members of the Institute have the right to form part.

Grand Prix (or First Prize.)

The competition for this prize is given and judged by the members of the Institute only.

The 1st Trial (with a view to compete) is a sketch in twelve hours. The students of the 1st, as also those of the 2nd Class, who have obtained medals in Mathematics, Perspective, and Construction, have a right to take part. The students who have gained a medal in the 1st Class are exempt from this competition, and have a right to join the *2nd Trial*. Fifty students are received.

2nd Trial.—These fifty students compete in sketches made from a given particular in twenty-four hours, and of the fifty only *eight* are received.

3rd Trial.—The eight students have then to prepare a sketch (as before) according to a given particular, for which ten days and ten nights are allowed, during which time they are placed in separate rooms, under strict surveillance, and are not allowed on any account to leave the premises; after which, four months are allowed to make the finished drawings in the said rooms of the academy. The judgment is given by the members of the Institute, who are architects, which judgment is afterwards ratified by the rest.

The Chairman (Mr. Tite,) V.P., stated that on the present occasion the Council were desirous rather to collect information than to proceed to the immediate discussion of the principle involved in an architectural examination and diploma, as brought before them by Mr. Papworth's paper just read. The remarks which he (Mr. Tite) had made at the last meeting had not yet been distributed amongst the members,—a domestic calamity deprived them of the presence of the Hon. Sec. for Foreign Correspondence, who had paid great attention to the subject,—the unfavourable weather had kept many other members away—and under all these circumstances it would be better to postpone the further consideration of the subject. He had himself given to the members the Prussian system of examination; Mr. Burnell had just laid before them that of France; and the Spanish system had also been referred to in the able translation read by Mr. Papworth. Probably some gentleman present might be able to explain, from his own observation, the practical working of the German system; and if so, that, or any similar information, would be most acceptable.

Mr. G. R. Burnell, C.E., Visitor, stated that, from what he had seen of modern architecture in Spain, he was not disposed to think the system there pursued had succeeded; no works of excellence whatever having been produced. He had been endeavouring to obtain some information as to the Spanish examination, and if the discussion were adjourned,—in the propriety of which he entirely concurred,—he hoped to submit the same at the next meeting. He would, however, take the present opportunity of adverting to the comparison of French and English architecture instituted by the Chairman at the meeting on the 5th instant,—a comparison fraught with instruction to English architects, if read aright. In spite of the wonderful ability of the French architects, and their manifest efforts to arrive at something good and true, he believed that they had made a great mistake in the course they had adopted. They appeared to consider it a duty to break through all kind of architectural traditions,—whether classical or mediæval,—and to despise and renounce them altogether. They were striving to invent a style of their own, and one which they intended to be in accordance with the wants of the present day, and of the people around them. In this commendable effort they might eventually to some extent succeed; but at the present time he thought if any person wished to select a bad school of architecture, he could not do better than to study the modern works of France. The street architecture of Paris (well described to him by Mr. Papworth as the "bed-post and valence" style,) presented an extraordinary system of balancing supports and openings, and the introduction of small panels with very slight projections. He had measured a great many of these panels and pilasters, and found that the projections in many cases barely exceeded two-fifths of an inch! The mouldings were badly profiled, had no expression, and gave no shadow; indeed all the lessons of experience, and the optical knowledge of the architects of former days, appeared to have been cast aside. A low relief had been adopted in the ornamentation, something similar to the fret-work which Sir John Soane had introduced some years ago; and upon the whole he thought he could perceive an analogy between the modern architecture of France and that which prevailed in Rome at the decline of the Roman Empire. He suspected there was a greater analogy between the moral and political condition of a country, and the state of its Fine Arts, than was generally supposed; and if they were to examine such matters philosophically, instead of giving themselves up to the guidance of men who dazzled them with Lamps of Architecture, and attempted to crush them with wonderful "Stones" from Venice, they would do much better than they had done at present. The French people had no national character at present,—neither had their architecture. The abattoirs and other *practical* public buildings of the time of Napoleon I. had far more architectural expression and feeling than the new works of the Louvre and other recent structures. The architecture of the period of Louis XVIII. was as superior to that of the present time as the state of political freedom then was to what it is now. If the Bourse and the Chamber of Deputies were compared with the buildings erected of late years it would be evident that in architecture France had fallen from its high estate. The Chairman had regretted the excessive cultivation of mediæval art. He (Mr. G. Burnell) considered the exclusive study either of classical or mediæval art as a defect. Wren, Jones, and the other masters of modern architecture practised before the date of the books cited by the Chairman as the models from which the young architect could best study. Palladio, Scamozzi, and Vignola, reasoned for themselves, and modified the antique without studying it blindly; and this was the course which ought always to be adopted. The Chairman had also said that Sir Charles Barry had succeeded in infusing the spirit of Gothic architecture into the New Houses of Parliament; but it should be remembered that the mediæval architects paid due attention to general principles, and never repeated a style which had become obsolete; the style of the twelfth century was never repeated in the thirteenth; but now, in the nineteenth century, we were servilely copying details well adapted to a long antecedent stage of

art, but not to our present wants. In the Houses of Parliament the committee rooms were sacrificed to the passages; and in the British Museum the necessity for two stories internally with one external order, rendered both suites of rooms exceedingly inconvenient, low, and badly lighted. It was not by copying either classical, mediæval or cinque cento forms that any good could be done. At the same time, while the French architects were, as he believed, mistaken in the course they had pursued, he believed they were upon a truer path, and more likely to arrive eventually at something which would advance and elevate the art than their brethren in England.

Mr. H. H. Burnell observed, with regard to the ornamentation in low relief which had been adopted in Paris, it should be borne in mind that the streets there were narrow; the ground was dear, and a higher degree of relief would have involved great expense in the stone façades of that city. The houses were frequently erected before the design for the decoration was prepared, and, considering the width of the streets he doubted whether a greater projection in the ornamentation would be an improvement. Certainly, no architect employed in Paris to carry out the views and study the interest of his employer would erect a projecting cornice in Paris such as was commonly seen in London.

The Chairman, referring to his opening address, was desirous to make a few further remarks with reference to the exclusive attention to Gothic architecture. He very much regretted to see that style applied to buildings for which Classical Architecture was much more fitted; such, for example, as town halls and markets. Even for some churches, and for chapels especially, the architecture which was learnt in Italy, was much better adapted than that now in fashion, There was hardly a competition of any kind, but it must be in the style of Edward III, or something similar. In his own neighbourhood, he could not help noticing daily, in passing, two modern Gothic churches, without any fitness or congruity with reference to the elegant houses surrounding them. One of these was not accurate even as an imitation;—the other was very elegant indeed, but he could not conceive why a church of that sort,—excellently adapted for the situation in which our forefathers would have placed it,—namely, in the country, amongst trees, rural scenery, and low and moderate sized houses,—should be placed at the end of a modern square in London, with houses 70 or 80 feet high around it. The character and fitness of such buildings was too much neglected. With regard to the small amount of projection in French street architecture, he considered the fact would rather lead to the view that the Parisian architects were leaning to the wants of the place and the times;—and in like manner, in the enormous warehouses recently erected in London and Manchester, the necessities of the trade carried on within them,—such as obtaining large accommodation and a great many stories in height upon a limited site,—had led to an appropriateness of character and style which was highly creditable. Architects were not sufficiently independent in their modes of thinking. Their education was a short one, and was rather adapted to provide that which was agreeable than that which was necessary. It was too much the fashion to adhere to one style only at a time. The Greek mania of some years ago was as great a mistake as the Gothic mania of the present day; and it was necessary to understand that one style was fitted to one class of buildings, and another style to a different class, and that the study of both might be entertained. He had been much struck with the misapplication of Gothic architecture to modern purposes in visiting a very elegant church in Yorkshire, on the outskirts of a manufacturing town, in company with the agent of the gentleman who built it. After examining it the clergyman, who was also present, said that every thing in the church was excellent, except its fitness for the purpose for which it was built: The congregation could not hear, or sit with any comfort; there was no ventilation, and the warming was defective; the clergyman complained of the reading desk, and the pulpit being made of stone was so cold that he could not put his hand upon it; indeed the church altogether was so inconvenient that the people

would rather stay away than go to it. Yet this church was a most accurate and elegant imitation of the style of Edward III, wanting nothing but the rood loft and the priest, and the substitution of chairs as in Roman Catholic churches for the fixed seats: it displayed an utter want of fitness and of all thought, except as applied to the mere identical copying, with great skill and beauty, of a mediæval work,—with far greater beauty indeed than the architects and masons of Edward III.'s time could have shewn. Fortunately, in the city of London they were wiser, or such a warehouse as that of Messrs. Cook & Sons would have been twisted into some imitation of the Gothic style. Palladio and the great English architects of the 17th century thought for themselves; and although they based their designs upon the great types of Roman Architecture, they modified and adapted them to the requisite purposes. He was most anxious to impress upon all who heard him, and especially on the younger members of the profession, that, as Lord Bacon said, houses were built to live in and not to look at, and that churches were built to worship in, and to be adapted to a state of things which some of them, it was possible, might live to see altered; but which, whilst they did exist, must be provided for. The neglect of this necessity was strikingly displayed in the church he had already referred to, where the altar and communion arrangements were of the most inconvenient description, whilst on the south side of the altar were three sedilia, forming admirable seats, though there was no one to sit in them. In this, which was a large parish church, only twelve persons at a time could kneel to receive the sacrament, whereas there should have been accommodation proportionate to the wants of two or three hundred communicants on any given Sunday; a most enormous mistake, without reference to Tractarianism or any other *ism;* and a striking instance of the error of merely copying, without thinking of the purpose to which the copy was to be applied. In the Roman Catholic religion all the forms of Gothic architecture went right, but as applied to the Protestant ritual everything went wrong, and the buildings, although exquisite in themselves, were neither suited to their purpose, nor to the places which they too often occupied. These were his sincere opinions, although no doubt they would be considered very heterodox, rather than orthodox.

Mr. Hesketh, Fellow, inquired what kind of examination the Architectural Association contemplated, and whether it was to include mathematics, and any branches of physics.

Mr. Papworth said, that he could remember the question of an architectural examination being under discussion for the last 16 or 17 years, and the difficulty had always been to know whether the junior members of the profession would come forward and adopt it. The Architectural Association had nobly answered that question, and effectually removed the doubt. With regard to the kind of examination, he did not feel called upon to add anything to what he had already said; except that they could hardly do better than follow the system adopted in the Civil Service. Those gentlemen drew up the questions for themselves, and in the majority of cases the examinations had met with the approval both of candidates and critics. He believed Mr. George Burnell's memory had rather failed him in one point, as the Bourse and other Parisian buildings possessing the manly character which was now deficient, were erected under the despotism of Napoleon I. Differing from Mr. Burnell, he believed that the arts had often flourished more under a despotism than a republic, the times of Pericles, the Medici, the Popes, and Louis XIV, might be cited in support of this view. With regard to the question of copying, it was true that English architects copied the details of former styles most admirably, but both in classical and mediæval restorations it was too common to see a window copied from a first class building applied in connection with a door from an inferior one; or the door of a parish church, with the east window of a cathedral.

Mr. Fowler, Fellow, with regard to the same question of copying, observed that whilst great merit was due to those gentlemen who had so zealously applied themselves to promote the societies

formed in different parts of the kingdom for the study of archæology, and although great benefit had accrued from those societies, yet, at the same time, they had been very instrumental in establishing the practice of imitation. The majority of the leading members of such societies were clergymen, who had displayed excessive zeal, spirit, and activity in bringing to light remains which had been lost, and in getting them restored and imitated; and their strong predilection for the works of our ancestors rendered them insensible to the merits of any other style of art. Even the utmost fidelity of imitation, although desirable in works of restoration, was not desirable in rebuilding. He agreed with the Chairman in thinking that the very close imitation of mediæval architecture often placed modern architects in a very absurd position. The architect should be always guided by reason and taste; but in copying so minutely former styles, the architect abandoned his reason altogether. As an illustration of the extent to which people were led by adherence to precedent and a disregard of fitness, he might mention that when he was erecting Covent Garden Market he determined that the building should be one of utility, without affecting any pretence to useless ornament;—but during the progress of the work he was called upon by the Duke of Bedford to explain the omission of the triglyphs from an adaptation of the Doric frieze. This was only one of many instances which had occurred to shew that an architect was too often supposed to have no discretion of his own, but was bound to have authority for every thing he did. With regard to street architecture, he thought the style which had been imported from Italy was striking and effective, and was a great step in advance on former styles; but the characteristics of that style were sometimes carried out in unsuitable positions. Thus, in rebuilding a house which had fallen down in Wood Street, the very handsome front of the new building was surmounted by a cornice projecting more than four feet, the street being about sixteen feet wide. If, therefore, the houses on the opposite sides were to be rebuilt with a similar cornice, the sky seen from the street would be reduced one half. Probably the Legislature had never contemplated the possibility of any thing so absurd, and therefore there was no law to prevent it; but he considered it a grievance which ought to be restrained as an offence against propriety and common sense. He hoped the time would come when reason would be followed, and servile imitation would be deprecated.

Mr. George Burnell, C.E., referred to the drawings in the room of the Tower of Antwerp Cathedral, which he observed was erected in [1588]; about the same period as St. Peters, at Rome; a sufficient proof that the architects of that age did not copy from one another.

Mr. Cates, Visitor, stated that the Architectural Association had unanimously agreed to a memorial on the subject of the diploma, which would be laid before the Institute.

Mr. Papworth moved the thanks of the meeting to M. Lance for his kindness in laying his paper before them, and the Chairman added the thanks of the Meeting to Mr. Papworth for his able translation and comments. The vote being unanimously agreed to,

The meeting then adjourned, with the understanding that the discussion on the diploma, as called forth by Mr. Papworth's paper, would take place at the next meeting on the 3rd of December.

DISCUSSION ON A DIPLOMA IN ARCHITECTURE,

Held at the Ordinary General Meeting of the Royal Institute of British Architects, December 3rd, 1855.

The Chairman, Mr. Tite, V. P., adverted to the suggestion which had proceeded from the Architectural Association in favour of a professional examination and diploma, and stated that the Council of the Institute had now received a memorial from the Association to the same effect; and although that document could not be discussed as a matter of detail, yet the question of principle,—whether the Council could constitute such a body of examiners as might increase the confidence of the public and the value of the profession,—was now before the meeting. Since the last meeting he had received from Mr. Arthur Cates the syllabus of the course of examination to which the members of the Institute of Actuaries had voluntarily agreed to subject themselves. The list of scientific pursuits in which a system of examination was adopted had thus been completed—with the exception of architecture and engineering,—for it appeared that, under the sanction of the authorities of Lincoln's Inn, a severe system of examination had also been established for barristers, which it was expected would hereafter be legally enforced. Having already addressed the members at length on this subject, he invited the free and open discussion of it, and would suggest that, if any determination should be arrived at, it might be embodied in a resolution, affirming (or otherwise) the principle that an examination with a view to a diploma should originate with the Institute of British Architects.

At the suggestion of Mr. Papworth, Fellow, the following Memorial from the Architectural Association was read by the Hon. Secretary.

To the President and Council of the Royal Institute of British Architects.

The Memorial of the Architectural Association.

My Lord and Gentlemen,

Your memorialists, representing the younger members of the architectural profession, beg to lay before the Royal Institute of British Architects, their desire for the establishment of an examination, which should eventually serve as the basis for the issue of such a diploma as shall certify that the holder thereof is fully qualified to practise as an architect.

They have been induced to take this step, from the consideration of the difficulties which, in the present day, beset the early stages of architectural education.

In preparation for entrance upon their articles, in studies during the period of their sojourn in an office, and in the critical interval from the completion of their articles to the moment of commencing practice, the students of architecture are without sufficient guidance. In no case have they that important and valuable direction given to their several studies, which is found to be so successful an inducement to the complete mastery of other professions, and this evil produces its more important effects when students of architecture having completed their articles, commence practice on their own responsibility.

The want of proper knowledge on the part of the architect, combined as it is with a want of information on the part of the public, leads to many of the anomalies which are now so frequently observable in the practice of the profession, and to the presence in its ranks of many who have not the power, and in some cases, of those who have not the will, to uphold its credit.

So much attention has been lately turned towards the necessity of testing by examination

the competency of all candidates for public employment, that your memorialists are led to submit that the present is a highly opportune period for bringing the subject under your consideration. They feel that they are addressing those who represent the architectural profession, and by whom only an authoritative step towards the establishment of an examination, or the granting of a diploma, could be taken. They are also assured, that the senior members of the profession, could hardly take the initiative till the necessity for that course had been brought before them by those who have more recently entered the profession.

Your memorialists do not feel themselves called upon to enter into further details, because they are convinced that the members of the Institute must, from their position, be fully cognizant of the evil results of the present system; and therefore do not doubt, that the Council will take an early opportunity of organizing an examination, such as shall be found best calculated to aid and direct the student, and to bring the real qualifications of the architect before the public.

Alfred Bailey, *President of the Architectural Association.*

Mr. Papworth proceeded to read the following remarks:—

The advocates of the Memorial have urged only the principle of a diploma: for my own part, in order to treat the matter in its fullest bearings, I have assumed a plan and its leading details. The memorialists and myself are of one mind in this respect: we say that a diploma would have the advantage of adding to the consideration which the profession of architecture more or less enjoys; and indeed it is easily conceivable that a preliminary demand, upon those who wish to exercise that profession, for proof of some amount of acquired knowledge, would alone place the body of architects in a new position. . . . . Without doubt this diploma will not make a *William of Wykeham* nor a *Christopher Wren*, any more than a call to the Bar makes a *Cicero* or a *Burke;* but as it would represent a minimum of the knowledge indispensable to the public, it would be at one and the same time a recommendation to its possessor, and a guarantee to the public.

And, moreover, whatever may be said, the public ought not to be left to assure itself beforehand as to the capacity of architects: the public cannot possibly at present be a good judge of merits which it cannot itself test. We even say that the public should in such cases be treated as a minor, and that some authority, some guardian, should exist, not to hinder it from speculating foolishly if it likes, but to give it the means of saving property if it chooses. And this is felt by the Legislature, which establishes District Surveyorships, and by the Scottish examination, mentioned in the following letter:—

"The mode of application to be admitted as an ordained Surveyor is by petition to the Town Council, stating what branch of the profession the petitioner is desirous to be examined upon, and requesting that the Council would take him on trial with a view to his being ordained if found qualified. On receiving the petition the Council then generally remit to their Superintendent of Works, with one or more ordained Surveyors, whom they name to take the petitioner on trial, and to report to them on his qualifications, which being done, the petitioner is then requested to appear (if found qualified) on a certain day named, before one of the magistrates, when he is sworn to do justice, and has to find caution that he will do so. This latter part is a mere form; and, indeed, the whole proceedings have got to be a matter of form altogether. The examination is usually gone over in the course of two or three hours, and there are but few, if any, instances of an individual having been rejected. In my opinion, the ordaining of a Surveyor should be by the Architectural Institute, in Scotland, where there is no Institute of Engineers and Surveyors, and a prescribed course be given, on which the party should be examined."

If it is urged that the establishment of the Institute and its severity in carrying out its law of

expulsion, are guarantees to the public of the unimpeachable honesty of its members, we answer that is not enough—that is not a guarantee of those members possessing the amount of skill which only can elevate the architect above the uneducated persons who arrogate his title. And it must be recollected that the Institute is not the profession: it is a club, so to speak, chiefly of London Architects; for it is a vain assumption to call ourselves the Institute of British Architects when similar societies in Dublin and Edinburgh, (not to mention those in Birmingham, Bristol, and Liverpool, and those anomalous associations, called Diocesan Architectural Societies,) have been formed and are forming, entirely independent of the Metropolitan Body, and therefore not following the example of Glasgow in relation to Edinburgh. As such a club, the Institute cannot do more than constitute a Board of Examiners, with the control and consideration which our possession of the principal Architects in England as a chartered Body under Royal patronage can give to a committee of ourselves.

There have been competing opinions as to the preference to be given to the Universities, the Examiners, a general Association, or the Institute. The Universities might follow our example if they found it well so to do; the examiners would be subordinate to ourselves; an association will never be formed, and therefore the Institute, especially if it should obtain an amended charter, seems to be the body which, as professional men, we should prefer.

If it is suggested as a question whether the Institute can act (in accordance with the views of the Memorialists) under the charter, I shall only mention the decision of the Institute as to establishing the classes of Honorary Members and of Honorary and Corresponding Members, which are not mentioned in the Charter although the corporate seal of the body is affixed to their brevets.

It was very gratifying that the last meeting received with satisfaction the idea that taste cannot even be a question for the examiners; but that readiness with the chalk, the brush, and the pencil, are indispensable to the man who lays claim to the title of architect.

That meeting seemed also to consider that the examiners should avoid the fault of the Continental systems, and not ask questions upon formulæ and facts to test the memory of a candidate crammed for the occasion, and ready to forget all on the next day,—but put such questions as a candidate may be expected to answer, by referring to works in the library of the Institute. It is not what a man can recollect, but his knowledge of how to use and where to find information, which is the great secret of the skill of the architect as a scientific man, and of his knowledge as an archæologist.

For my own part I sincerely hope the examinations will be public, *i. e.* will be held in the presence of any graduates who choose to attend them; the examining body should at first be composed of those who occupy a high station with the profession and with the public,—hereafter those who take the highest honors would replace them as occasion should demand.

To facilitate the adoption of the diploma, I imagine the adoption of a chairman, who should be, if possible, a President of this body. I imagine that the three Professors, Messrs. Cockerell, Donaldson and Hosking, would not refuse to accept the diploma at his hands; and then we have a Board who could give to all qualified persons, who have practised legitimately during the last few years as architects, the diploma of Master in Architecture, and to those who have been so engaged for a short time only, the diploma of Bachelor. I suppose that some would be found to deserve the most honorable degree of Doctor in Architecture.

At the end of three years the examinations should be stricter, and at the end of five years they should have attained the ultimatum, for a time, of their severity; then the profession would be in such a position as it cannot at present hold; and might reasonably hope to procure the adoption by the Legislature of a Bill against quack-architects.

It must be evident that the severity of examination for these degrees must be relaxed for the first

three years: there are men of established repute whose neglect of the diploma might be hurtful at first to its existence, and who might not choose to do more than present themselves personally to claim it; and this class must be consulted in order to facilitate the transition.

Then, when the examinations are fixed, the Board would only have in the first year to verify the position held by the candidate, and his power of making before them a tinted sketch and an outline of detail, in order to hand to him their certificate of the ordinary degree of Master or Bachelor, as the case may be. While if the candidate apply for a higher degree than that which he would ordinarily claim, we should all rejoice at his being found worthy of it.

The exemption of any candidate from examination would be a fatal error; nor should any candidate be allowed to pass upon a lower standard than that fixed for all comers.

It is hardly less desirable to fix any limit of age to candidates, than to close the examination-room against any candidate, whatever may be his position in society; if he be found fit to practise as an architect, that qualification should entitle him to the diploma.

Hereafter, especially under an amended charter of the Institute, we may reasonably hope to entertain the establishment of lectures preparatory to the examination, which being open to the public, shall co-operate with the diploma in the attainment of our object as set forth in the charter, namely, the general advancement of civil architecture, and the promotion and facilitation of the acquirement of the knowledge of the various arts and sciences connected therewith; and in truth I look upon the diploma as only an expedient, for if we had a public sufficiently instructed to know what to demand of its architects, there would be no necessity for a diploma to guard the interests of that public, and district surveyors would not be expected to fulfil the duties of inspectors of public nuisances. The examination would be most honourable as a voluntary one.

The diploma cannot be the result of an imperative examination, without an Act of Parliament to that effect; and the Legislature will of course refuse such an Act until the profession has shown that the diploma is feasible and in operation. The Institute should never require the diploma of any candidate for election into its own body.

Professor Donaldson has announced in this room, as a matter of self-gratulation to us, the establishment of certificates in two colleges. And the Royal Institute of British Architects (I must use in this case the full name) having obtained at its own request the legal right of examining candidates for District Surveyorships, cannot with a good grace refuse to accede to the nobly disinterested application made in such well considered terms and at so well chosen a time by the Architectural Association, of which (and I am proud to say it on this occasion) the most active members are chiefly associates of this Institute.

Mr. Bailey, Associate, begged to offer a few remarks on the part of the Architectural Association. In reference to the kind of examination which they contemplated, the Association had been very careful not to presume to dictate to the Institute in any way. He might however observe, that the qualifications required in the Spanish system which had been submitted by Mr. Burnell, were of so low a standard, that it seemed impossible that the system should succeed. On the other hand, the qualifications required on the Prussian system were too high. The latter, however, was part of the academical system at Berlin. The Architectural Academy there was held in a public building, and the examination was based upon the subjects taught in that academy. Like all Germans, the Prussians were highly educated, but they certainly were not a practical nation. They possessed many highly qualified and scientific architects, but the public did not appreciate or place confidence in them. Thus, in Berlin, nobody was heard of but Schinkel, or in Munich, but Klenze; in the small towns there was merely the court architect and nobody else; a great number of highly qualified young German

architects remaining in what might be termed a state of armed neutrality. In the Prussian scheme of examination there were many things not indispensable in an architect, although perhaps highly desirable; and it might be praticable to grant a diploma upon an examination on the indispensable points; the examination on the other desirable matters being only a question of honor. Mr. Hesketh had suggested mathematics, a subject too much neglected by young architects. No doubt, this subject should be included, but to what extent might be questionable. Algebra, and plane trigonometry, were of course indispensable, but it might be doubted whether the differential calculus was essential, and certainly it appeared absurd, that a man should not pass his examination as an architect, without being acquainted with short-hand! It had been urged, that too stringent an examination would deter many candidates, but on the part of the young men who had suggested it, he could assure the meeting, that they felt that, to be of any use to them, the examination must be severe; such indeed, that it should be no disgrace to a man to go up and get "plucked" even two or three times. He would thus discover his deficiencies, and be enabled to study further any subject which he might have previously neglected. The question of honours was rather a matter of detail, but if high honours could be taken, it would be of great use to the young men. Mr. Papworth had said, that the fact of passing an examination ought not to constitute a qualification as a member of the Institute, but on that point he differed with Mr. Papworth. At present, no previous examination as to ability being necessary, but merely respectability, the personal acquaintance of three architects, fellows, and sufficient wealth to be able to pay the annual subscription, no honour was attached to the fact of being an associate. Mr. Papworth had further observed, that the question of taste must be left out of the examination, and here also he differed with that gentleman. He knew more than one London builder who could pass an examination with great credit, if nothing more was required than the capability of making an outline detailed sketch, and a certain facility with the brush and the pencil, although they might be totally unable to make a creditable design. The examination should not be one of facts and formulæ, and if a design were submitted, the examiners would easily be able to see whether the candidate had gone through a sufficient course of study. It had been objected, that certain examiners would be prejudiced in favor of particular styles (the bugbear of "styles" being raised on all occasions); but he did not believe this would be the case, or that the Chairman, if on the board of examiners, would reject a good design merely because it was Gothic. On the last point raised by Mr. Papworth, he entirely differed with him. To ask a fellow of the Institute to pass an examination, was absurd and impracticable; as it would in that case be impossible to draw the line between the examiners and the examined. If among the elder members of the profession, there were any wanting in some of the necessary qualifications, they would gradually die off, and their places would be filled by younger men. In conclusion, Mr. Bailey expressed, on the part of the members of the Association, their thanks to the Institute for the kind and prompt manner in which the subject had been taken up. The elder and the younger members of the profession knew far too little of each other, and if the agitation of the present question had done nothing more than bring them somewhat more into communication with each other, it would not have been brought forward in vain.

Mr. G. R. Burnell, Visitor, read the following statement of the course of examination in the School of Mines and the School of Engineers, in Spain.

Course of Study in the Special School of Mines.

Previously to 1847 it was necessary that candidates for situations of Ingenieros de Minas should pass the examination described below; and follow a course of study, also subjoined, lasting three years, before they could be admitted into that body.

The preliminary examination consisted of—

1. The presentation of a certificate that the applicant was not less than fifteen or more than twenty-five years of age, and that he had no physical or constitutional defects.
2. An examination in Arithmetic; Geometry; Algebra, as far as the solution of Equations of the second degree; application of Algebra to Geometry; Trigonometry, rectilinear and spherical; Practical Geometry and Conic Sections; Experimental Physics; General Principles of Chemistry; Lineal and Topographical Drawing; and the French Language.

The Course of Study consisted of—

First Year.	Second Year.	Third Year.
1. Mineralogy.	1. Geology.	1. Construction.
2. Working of Mines.	2. Special applied Mechanics.	2. Practical Essays of Doximastics.
3. General Principles of Metallurgy and Doximastics.	3. Special applied Metallurgy.	3. Formacion de la cartera del Ingeniero. (Mode of keeping Records.)

Since 1847 this Course of Study has been altered thus:—

First Year.	Second Year.	Third Year.	Fourth Year.
1. Applied Mechanics, and mechanical preparation of the Ores.	1. Construction and Stereotomy.	1. General Chemistry.	1. Analytical Chemistry.
2. Mineralogy.	2. Paleontology.	2. Doximastics and general Metallurgy.	2. Special Metallurgy.
3. Geology.	3. Working Mines and Subterranean Geometry.	3. Administrative Law; 1st Part.	3. Administrative Law; 2nd Part.
4. Drawing and its applications.	4. Drawing.	4. Drawing.	4. Drawing.

Salaries, 5000, 6000, and 9000 reals.

Course of Studies in the "Escuela Especial de Ingenieros de Caminos, Canales, y Puertos."

Previously to 1847 the Course of Study lasted for five years, and was divided as follows;—

First Year.	Second Year.	Third Year.
1. Integral and differential Calculus, and analytical Geometry of three dimensions.	1. Rational Mechanics.	1. Stereotomy.
2. Pure Descriptive Geometry.	2. Topography and Geodesy.	2. Civil Architecture.
3. Physics, and Principles of Chemistry.	3. Mechanics, as applied to Construction.	3. Mineralogy and Geology.

The Students were then examined, and they who passed continued.

Fourth Year.	Fifth Year.
1. Knowledge of Building Materials, formation of Roads, and ordinary Bridges.	1. Railways and Locomotive Engines.
2. Applied Mechanics, especially with reference to Steam Engines, and the elevation and distribution of Water for the use of Town Populations.	2. Rivers, Canals, Harbours, Drainage and Irrigation Works.
	3. Administrative Law, applied to Public Works.

In 1847 the Course of Study was altered, and its duration limited to four years. It is now conducted as follows:—

First Year.	Second Year.	Third Year.	Fourth Year.
1. Applied Mechanics.	1. Construction; 1st Part.	1. Construction; 2nd Part.	1. Construction; 2nd Part.
2. Stereotomy.	2. Machinery.	2. Civil Architecture.	2. Hydraulic Engineering.
3. Mineralogy.	3. Geology.	3. Administrative Law; 1st Part.	3. Administrative Law; 2nd Part.
4. Graphic and Practical Exercises.	4. Drawing, theoretical and practical.	4. Drawing, continued.	4. Drawing, and practical application of the various theories previously taught.

See Madoz' Diccionario, &c. vol. 10, p.p. 821, 822.

Having resided for eight years on the continent, he (Mr. Burnell) had ample experience of the diploma system, and it appeared to him that it had signally failed, and he believed, if adopted compulsorily in England, it would not produce any good result. The system in fact compelled those who aspired to public situations to go to the schools in which the particular education required for the diploma was given, and thus the tyranny of schools was substituted for the former tyranny of corporations. Moreover, a species of monopoly was established which was fatal to originality and individual character. The Chairman had stated that there was a species of examination for lawyers, but the system of "cating terms" which had so long prevailed had produced results of which, as Englishmen, they had no reason to be ashamed. The experience of the present war was not in favour of the system of examination in our own and other great military academies; indeed the only really great general, Omer Pacha, had not gone through the discipline of the schools. Again, the French engineers were, perhaps, the most learned and scientific body in Europe, but (with the exception of the improvement of the lighthouse introduced by Fresnel) none of the great modern improvements in engineering had originated in France. The application of cast and wrought iron to buildings, the improvements in suspension bridges, railways, docks, the electric telegraph, locomotive and other steam engines, gas lighting, &c. had all originated in England or America, where the profession was open to all comers and without monopoly; and this system, he was convinced, would be the safest and the best for the public. With regard to the consideration in which architects might be held by the public, the question was different, and certainly if a diploma had been necessary to practise as an architect, the public would not have heard so much nonsense as had been promulgated of late years by the various quacks who had thrust themselves and their schemes forward to attract public notice in matters of sewerage, drainage, &c. Whilst, therefore, he was decidedly against the diploma system, he admitted that as giving greater consideration to the qualified architect much good would be effected. This, however, was not a question which the profession, *quasi* architects, ought to take up. It had been urged in France that the introduction of diplomas would assure to architects a certain fixed position, and that many would be induced in consequence to settle in the departments. It was not, however, desirable that architects should put themselves forward as seeking to obtain better positions for themselves; they should only consider whether the interests of the public, truly understood, would be advanced by the plan proposed, and his (Mr. Burnell's) experience in all the countries he had travelled in went to convince him that it would be productive of a diametrically opposite result.

Mr. Pocock, Fellow, observed that in a profession embracing both art and science, a system of examination must involve uncertainty and difficulty. One individual, with great natural talent, might possess small yet sufficient acquirements in science and practice. Another, with a small but sufficient modicum of art, might possess so large an amount of science as to make a better display than he whom nature had endowed with more of the talent of the artist. The great difficulty in the question, indeed, would be in dealing with the distinction between the architect as compared with the mere builder, and in conferring a diploma which should properly point out the qualifications of each. Even *a priori* he concurred in the *a posteriori* conclusions of Mr. Burnell, that the diploma system would lower rather than raise the standard of professional ability. There would be a great difficulty in fixing the exact standard for the examination. Unless it were sufficiently high, a great many men who now aspired only to rank as builders would be able to pass it, and the modesty which now restrained them from passing off as architects would not be felt if they could obtain a diploma as being properly qualified. The consequence would be that the profession would swarm with obscure and unknown men, and not with the Cubitts, the Petos, and the Bakers, who were too glad to practice their art under the direction

and with the assistance of architects. This result would at once destroy all the eclat which might otherwise be derived from the possession of a diploma. The only way of preventing this would be by raising the standard of examination so high that these larger bodies might not be able to pass. This however, would also defeat the object. It would, by running too much into detail, restrict very much the number of those who would conform to it as a voluntary examination, and in art especially there would be great difficulty as to the qualification. A man might read himself up in geometry, geodesy, or other matters of science, but the talent of architectural design could not be acquired; although any builder of good practice would be able to draw a portico, a summer house, or something equally elaborate. A diploma would doubtless be valued by a young man, whom the public might hesitate to employ without it, but if the title of architect was reduced in value by this proceeding, the young architect would no longer be thankful for it.

Mr. H. H. Burnell, Associate, stated that he had received communications from Professor Förster, and other foreign architects, warning the profession against the contemplated step as tending to trammel enterprise in every way. No doubt every young architect must find some difficulty from a deficiency of technical knowledge; but his principal difficulty arose rather from contact with parties with whom he had not hitherto been connected. They were necessarily exposed to the tricks of builders, and other evils, against which experience alone could protect them, and in reference to which any examination must be useless. It appeared to him also somewhat ungracious that any professional body should seek for an examination for themselves. In the other professions such a system had been adopted by the legislature, or enforced by society finding the necessity of protection. He did not think society felt that want very much as regards architects; and moreover, it should be remembered that before examination came instruction, and it would be necessary to have schools in which to instruct pupils in the subjects of examination, because at present in an architect's office the pupil only learnt experience and business. Mathematical skill of course could not be shown without an examination, but the possession of taste and artistic talent might even at present be displayed by exhibiting at the Royal Academy, and by competing for the prizes of the Institute, and the Association.

Mr. Penrose, V.P., thought, considering the course which the discussion had taken, it would be impracticable to come to any conclusion at the present meeting, as it was most desirable that the subject should be fully discussed. He trusted the objections which had been raised would not divert attention from the noble manner in which the Association had come forward. The discussion could not be limited to the principle of the question, as their judgment must be formed from a careful consideration of its details; although their decision, when arrived at, would be a mere affirmation, or not, of the principle. The danger pointed out by Mr. Burnell of the tyranny of schools would be a real and serious evil if not foreseen and obviated, and this danger the adoption of any thing like the Prussian system would peculiarly involve. In the analogous case of the Universities, the authorities, in preparing young men for the different pursuits of life, did not point out any particular line of study as fitted for any one profession; yet in the recent examinations for the East India Company's and other appointments, the Universities, and especially Oxford, had been very successful. He considered this an argument in favour of an examination for a diploma,—if it were not granted in an exceedingly concrete form,—or as pointing out one particular cut and dried line of architectural practice. The examination should rather be on certain subjects allied to architecture, and indispensable to the profession, but should be so contrived as not to hamper the student in forming original ideas. There could be no tyranny of schools in teaching geometry, the value and properties of building materials, the proper methods of estimating, or similar scientific points; but it required very delicate handling to

know whether the artistic principle should be introduced at all. The danger which Mr. Pocock had mentioned of rendering the diploma too easily attainable, would, in his opinion, be more likely to ensue if the artistic principle were introduced in the examination, but this was a matter of detail which he would merely suggest for consideration. If the diploma merely ensured that the person holding it was duly qualified in certain indispensable studies, it would do much good, and would probably be better than a more decidedly architectural examination.

Mr. Jennings, Fellow, suggested that there might be different examinations and different classes of certificates, the mere passing of the ordinary examination being sufficient for a district surveyor. The examination for the district surveyorship had, in fact, already been thrust upon the Institute by the legislature. It did not appear to him that there would be any great difficulty in the artistic question, because the examination would rather be on the knowledge of what had been written, and was before the world, than on what the candidate could do with his own pencil. All examinations indeed must be as to the possession of knowledge, and there were rules which an architect would be expected to know, though a builder would be less likely to be acquainted with them. He thought the subjects might be so divided that the candidates might pass with more or less success; just as a person could regulate his own subjects in going up for honours at the Universities. There were some difficulties in the details of the question, but they were not insuperable, and he trusted the meeting would agree that some sort of examination was desirable. The Council *must* settle the kind of examination to be required for District Surveyors, and probably the best plan would be to refer the general question to the Council also.

Mr. C. Barry, Fellow, considered the practical working of the existing systems a matter of great importance. It was most desirable to learn their actual effects; or, believing them to be more or less failures, to ascertain why they had failed. He confessed that the schemes which comprised such a long list of acquirements, not only scientific and artistic, but of every discursive nature, seemed to contain within themselves the secret of their failure. It was the bounden duty of the profession to take such steps as might assure the public against malpractices, but he thought their labours should end there. The born artist would make his way with his natural endowments, which could not be taught, and which no examination could bring out. At the same time there were artists highly capable of influencing generations by their ideas of art and beauty, but perfectly incompetent to be entrusted with the execution of buildings. It was desirable, therefore, that such artists should be either associated with practical men, or themselves become practical, if any kind of examination could make them so. It was desirable not to confound the architect with the builder. The daily business of a builder, if a thinking man, must make him practical, but he questioned whether such a man would care to submit to an examination on those points; but it was important that an architect, who was not so evidently immersed in practice alone, should give some evidence of his practical ability. He therefore agreed with Mr. Penrose that the examination should be a practical one. A compulsory examination would contain the germ of failure, because it involved a degree of trammel and hindrance to original effort and exertion; and certainly it would be quite impossible to make it imperative on the old as well as on the younger members of the profession. The only object of an examination was to prove competency, and the fact that the older members of the profession had attained a high station was sufficient proof to the world that they were perfectly competent, and independent of any kind of examination that could be organized.

Mr. T. H. Lewis, Fellow, referred to the objection that without a stiff examination builders would be able to practice as architects also. His knowledge of first-rate builders convinced him that they would be able to pass a stiff examination; but a very slight qualification or undertaking would be

sufficient to prevent their taking a diploma as an architect. They should declare before examination that they did not intend to practise as architects. He should be happy to see builders come forward and pass an examination, but it should be as builders, and as builders only.

Mr. C. Fowler, jun., Associate, called attention to a recent leading article in the Times newspaper in reference to the proposed "Nightingale Fund," the writer of which advised the promoters of the scheme "not to waste money on an architect," the idea evidently being that the province of an architect was merely to make an ornamental design, and that he had nothing to do with the practical or economical execution of it. That opinion was no doubt shared by a large portion of the public, and if it could be removed by granting a diploma, a great advantage would be gained; but there might be a doubt whether such would be the result.

Mr. I'Anson, Fellow, remarked that the common sneering at professional men was not confined to architects, being shared by the clergy, lawyers, and medical men. The question before them was, how far the public would benefit by the plan proposed, and he did not think it would be worth anything to the public. The public would go to clever men, no matter how they had got into the ranks. Sir Joseph Paxton, the originator of the Crystal Palace, was a striking instance of this; as he had now considerable practice as an architect. Rennie and Stephenson had risen, by their own genius only, to be among the greatest of modern engineers; and numerous other instances might be cited. A diploma would not keep out unqualified men. A builder with a little more pride than his fellows might become an architect, and, if he possessed talent, as good an architect as those who had gone through a professional career. A diploma might give confidence to young men, but they had already a diploma in having gone through an architect's office, and in having their articles endorsed. Upon the whole he did not see how a diploma could benefit either the public or the profession.

Mr. A. J. Baker, Associate, regretted that nothing had been said as to a more extended architectural education, a subject with which Professor Donaldson was familiar. A better education for architectural pupils was much required, and he hoped the subject would be taken up by the Institute on a future occasion.

Mr. Henman, Associate, observed that whilst architects of established position should not be subjected to examination, young architects should not at once obtain a diploma, placing them on the same footing as the senior members of the profession, The late Mr. A. Bartholomew had proposed examinations and diplomas of four different grades, and he (Mr. Henman) thought some such plan would be more feasible and practicable than that now proposed.

The Chairman stated that he was almost inclined to consider Mr. Papworth's proposal as a *joke*. So far as he (the Chairman) was concerned, there had, in fact, been no idea of subjecting architects already in practice to an examination. They would otherwise have to examine the examiners! The object he had in view was to elevate the profession. They were often told that English architects had no chance as compared with those of France. That he believed was a mistake; but if true, it was from the want of architectural education; and that education would be promoted by a system of examination. He did not ask the Council of the Institute, and the examiners who might be appointed, to examine *builders*—let the Builders' Society do that if it thought proper; the real object was to raise a body of scientific *architects*. He could perfectly understand a man ceasing to practise as a builder, and becoming an architect, but the custom of practising both as a builder and an architect was a grave blot upon this country, and he believed it was unknown in others. A distinct line of professional education should be required, and about which there could be no mistake; and the only way to effect that was by enabling students, after leaving an architect's office, or after a course of study under Professor Donaldson or Professor Hosking, to come to a body willing to recognize them, and inquire into their

attainments, and to see that they had been directing their studies in the right course. The public would then know that the candidate had been well taught, and was competent to undertake their business. It was said the French system did not work well; but *there* a system of minute classification had been adopted which trammelled the mind. All such mistakes were easily avoided, and the whole plan should be as free as it could possibly be made. Some of the objections now urged arose from ignorance at what had passed at the former meeting. The majority of course would bind the meeting; but when the Government advocated an examination for District Surveyors, when one learned profession after another desired to institute examinations, and when the younger members of their own profession came to them and asked them for an examination, he put it to the meeting whether they ought not to adopt it. Notwithstanding the great names which adorned the legal profession, barristers knew that the present system did not ensure the attainments which their profession demanded, and therefore they proposed a system of examination. As the memorial before the meeting urged, it was the duty of the Institute to teach students of architecture the proper course of study, and there could be no better introduction into life and society than the fact of having passed such a voluntary examination as was proposed. Probably the suggestion of Mr. Jennings was the proper one, viz., that the subject should be referred to the Council; or, if the meeting thought fit, the discussion might be adjourned. In that case it should be understood that those who had brought the subject forward did not want it to assume the character which had been attributed to it by some of the speakers present. It was not at all meant in the sense of that evening's argument, but merely that a proper direction should be given to scientific education, and that they should if possible redeem themselves from the prejudice which existed abroad, that they were not as competent as foreign architects. The remark in the Times was meant to apply to extravagant and foolish expenditure, such as the erection of a fine Gothic building for the reception of a miserable collection of unhappy paupers. The public should be educated, so that they would not (as at present) choose the prettiest design offered in competition without regard to its appropriateness or expense. The Council were in the hands of the meeting as to the course which should now be pursued.

On the motion of Mr. Ashpitel, Fellow, the discussion was then adjourned.

ON SOME FRENCH CHATEAUX OF THE AGE OF FRANCIS I.

By Edward I'Anson, Fellow.

Read at the Ordinary General Meeting of the Royal Institute of British Architects, Dec. 17th, 1855.

The subject on which I am about to address you is one which has no recommendation of novelty. The buildings to which I shall refer are, I doubt not, perfectly well known to you all, either from having actually visited them, or from pictorial representations; but it is on the very fact of the popular appreciation of these buildings, and on the pleasant memory of sunny hours which may have been passed by you within their precincts, and which may now be in some degree recalled to your mind, that I rely for whatever interest may attach to the subject I have the honour to bring before you.

I had indeed selected and in part prepared a subject of greater novelty to myself. I allude to the remarkable group of Byzantine churches at Perigueux and its environs, which have been touched upon by Mr. Petit in his Architectural Studies in France; but as I found they had been already fully described by Professor Donaldson, I have fallen back on a subject, which though more familiar, is, in its kind, not less interesting. I do not purpose to give any detailed chronological account of the dates of these buildings, or of the history of the times in which they were built. It is now, I find, ten years ago since I had the honour of reading in this room some account of the history of Renaissance art and its professors in France; but the subject appears to demand that I should as a preliminary refer to that connection which arose between France and Italy consequent on the wars of Charles VIII. in 1494; of Louis XII. who, five years later, invaded Italy, and of Francis I. who, crossing the Alps in 1515, there gained the battle of Marignan.

At that time, after ages of change and struggle, Europe had assumed nearly its present political division of kingdoms and states. Italy had reached a state of high cultivation; ancient literature, which had there never been wholly lost sight of, was revived; printing had just been discovered; religious inquiry had commenced, and the Reformation was about to take place; material riches had accumulated, society had become formed, and intellectual activity characterised the age.

In architecture the Alps divided two very different styles. On the north side, the colossal transepts of Beauvais were being built, and the lofty spire of that cathedral, which has long since fallen; whilst its cotemporaries, the spire of Antwerp and the unfinished tower of Mechlin, remain amongst the greatest works of any time or country. On the other side of the Alps, the great dome of Florence had been built, and the mighty fabric of Saint Peter's was progressing.

Irrespective of foreign influence, it is certain that Gothic art had outgrown itself; it had grown as a stately plant on the ruins of debased Roman or Byzantine art; at first slightly decorated by curling leaves, narrow, nervous, and sparse, as in our early English of Lincoln; developing itself little by little, growing more pulpy and full, as at St. Alban's nave or Beauvais choir; breaking out into more luxuriant branches, with the buds abundant, as in our early Decorated, and the flower expanding itself as in the days of our Edwards; until at last, in the full luxuriance of the French Flamboyant and the late German styles, both more beautiful and picturesque than our late Gothic, the flower had expanded sometimes to an unnatural size and bursting luxuriance, shedding its ripened seed; but whilst the flower grew, the original stem in French architecture had lost its form and significance; its roots had become crystalized into the most complex forms; in Germany the stem had been lopped and pruned, wreathed, intertwisted, and twined, until its early upward tendency was lost, and the

style in both countries had grown into a still luxuriant but feeble condition. In this state it was ready to receive the impress of any new thought, and accordingly we find that no sooner had the French become acquainted, through their intercourse with Italy, with the revived classic architecture which flourished there, than they at once adopted it. Not that it had at first any perceptible effect on the structural character of their works, being only introduced as decoration; of which we have very excellent examples in the screen surrounding the lady chapel at Chartres, a Flamboyant work most elaborately and exquisitely wrought, with a profusion of ornament of the Italian Renaissance; and the arcade next the court yard of that part of the Palace at Blois, which is of the period of Louis XII., the whole of which is one of the most perfect and characteristic specimens which exist of the late Gothic of that Monarch's reign, and to which I shall again have occasion to refer.

The new style once having taken root was not, however, long in fully developing itself, and under the fostering patronage of Francis I., who ascended the throne of France in 1515, at the early age of twenty-one, it rapidly rose into great importance, and several remarkable works were produced which will always remain as models of true and original art.

Amongst the most important in point of size, and for its historical associations, may be noticed Fontainebleau, a spot not less known from its magnificent palace than from the natural beauties of the great forest which surrounds it. Fontainebleau, like most of the chateaux, is of old origin; an ancient feudal house, added to or destroyed, and new buildings raised in its stead. It was the favourite residence of Francis I., who made it the cradle of the arts, and the chief seat of his Court; from his day to the present it has been connected with the history of the French Kings, particularly so with the first Napoleon, and it owes much of its present splendour to the care of the lately deceased Monarch Louis Philippe. By his munificent patronage Francis I. here founded and maintained a school, called after him the School of Francis I.; and by his liberality have become associated with this palace the illustrious names of Leonardo da Vinci and Benevenuto Cellini, Andrea del Sarto, Sebastian Serlio, Primaticcio, and le Rosso. Primaticcio was the artist engaged for the greatest length of time; he had a fixed salary of 1200 livres a year, besides many marks of royal favour, and was assisted by Gio. Battista Bagnacavallo, Rugieri da Bologna, Prospero Fontana, Damiano del Barbieri, and Nicolo dell'Abate da Modena, which names I cite to show how much was done to introduce the revived Italian art. Fontainebleau continued to be the residence of the King, who here not only encouraged the arts, but also greatly increased the library. All the buildings round the Cour Ovale are of the time of Francis I., also great part of the Cour du Cheval Blanc, which was either entirely rebuilt by him or very much altered. He here sumptuously entertained Charles V, and on the occasion of the birth of his grandson, afterwards Francis II., born of Catherine of Medicis in 1543, he gave a great fête; and two years later, at a similar fête in honour of the birth of a princess, Henry VIII. of England was represented by Admiral Lord Dudley. Francis died in 1547, and to the last so great was his love of Fontainebleau that in going there he was accustomed to say, "Je vais chez moi." Henry II. and Diane de Poitiers his mistress, rather than his Queen Catherine of Medicis, reigned at Fontainebleau, and continued the work which Francis had begun. Catherine de Medicis, during her long regency, enriched Fontainebleau with statues, bronzes, and pictures; she made additions to the Cour du Cheval Blanc, and built a staircase in the place occupied by the present staircase du Fer à Cheval, which is a much later work.

The names of Henry IV. and Gabriel d'Estrées are next connected with the progress of Fontainebleau. Henry, besides other minor works, built the large court bearing his name, for the more convenient accommodation of his retinue; it is a distinct building, and wants much of the interest of

the older buildings of the time of Francis. The other buildings of the Palace are all of later date, and of a style on which our attention is not now engaged. Henry IV.'s eldest son, afterwards Louis XIII, was born at Fontainebleau, in 1601.

The Chateau of Blois, the next to which I shall allude, is placed in the middle of the town. The most important part is of the time of Francis I., but it is highly interesting as a work of art of many ages, as well as from its historical associations. It is a considerable pile of building surrounding an open court, and referable to three very distinct periods:—one of or antecedent to Louis XII. the second that of Francis I; and the third one of a later date. Of the older buildings, are the Sal le des Etats, a very fine room of the XIIth Century, and the Tour des Oubliettes, part of the old castle, which is now masked by the works of Francis I.

Louis XII. was the first royal resident of Blois, but it had already undergone considerable alterations and improvements under his father, Charles Duke of Orleans, who was long a prisoner in England. Louis XII. was born at the Chateau of Blois, and it was his favorite residence in after years. The exterior façade of the portion built by him was finished in the month of December, 1501. The whole of this building is a very remarkable work; it is of brick with stone dressings, and shews distinctly the incipient traces of the Italian Renaissance, to which I have before referred: it is considered by the French the most perfect specimen of late Gothic. As an example of domestic architecture, I know of nothing finer, and it has been very well given in a work published by Mr. Henry Clutton, in 1853. Louis XII. died in the year 1515, and the wing, known as the wing of Francis I, commenced by Louis, was carried on and finished it is said in three years. Next the court yard, its principal feature is its beautiful staircase; and the façade next the town rising from a rocky elevated base, and owing much of its dignity to the commanding site on which it stands, is a most graceful and dignified composition. The massive natural base on which it stands, supports a range of building consisting of three stories, surmounted by an open colonnade. The windows are, for the most part, deeply recessed and divided by flat pilasters, whilst three projecting windows, and one projecting balcony, diversify the general breadth of design in the happiest manner. The more modern portions of the palace were chiefly added by Gaston of Orleans, brother of Louis XIII.

Blois, which was in a very dilapidated state, has been nobly restored as to that part which is of the time of Francis I. This work is due to the care of the King Louis Phillipe, and has been most ably carried out by M. Duban, at a cost of 400,000 fr. (£ 16,000.) All the external sculpture has been carefully and successfully renewed—the glazing entirely replaced—the floor paved with tiles (the best rooms with encaustic tiles); the walls lined and decorated, the wooden ceilings redecorated, and the panelling to various rooms, and some magnificent chimney-pieces restored, the whole interior coloured, and in some rooms richly gilt; some part of the exterior colored and gilt; forming altogether the most perfect and pleasing example of the age of Francis I, which is in existence.

This building is now used partly as a museum, and partly for occasional festive meetings of the townsfolk, and at the period of my last visit, a few months since, its chambers, once the abode of Royalty and long the favorite residence of the House of Orleans, had served as an elegant series of ball rooms for the inhabitants of Blois. The great feature is the noble staircase. On each floor, one half the building next the court-yard is occupied by the Salles des Gardes, and the other half by a series of rooms of various sizes, generally with no communication except through each other and into the Salle des Gardes.

The next building to which I would refer, is Chambord, built in the year 1523, by Francis I. Henry II. continued the works, and it is said that these two Kings had 1800 workmen

employed upon them for thirty years. It was altered by Louis XIV, and disfigured by his architect Mansard, who divided the noble internal galleries into two stories, by wooden floors, and also materially altered the low building at the back, in order that it might accommodate the numerous retinue of the Grand Monarque. The building measures in front 80 toises, and is 60 toises deep; the four corners are flanked by four great towers; those at the back are now low, but in Ducerceau's view they are as lofty as the principal elevation, and thus materially add to the beauty and effect of the whole design. In 1749 they were low as they now are. The outer buildings enclosed an inner building, also flanked by four towers, the centre building is called the donjon. Each of these towers is 60 French feet in diameter. The central staircase is 30 feet in diameter, and from it radiate in the form of a Greek cross, four Salles de Garde, each 50 feet long, and 30 feet wide. These Salles de Garde are vaulted in stone, and have flat roofs. The panelling of the vaulting is ornamented with an alternate F, and the Salamander; the roofs are ornamented by quantité de cheminées très ornées, quantité de tourelles et croisées qui semblent récréer la vue de ceux qui se promènent sur ces terrasses. The central tower, about 100 feet high, is very much praised, the writer from whom I quote, an author of about a century ago, says it produces "le plus gracieux effet du monde." There are 13 staircases, and 440 rooms in the château. The design is attributed to Primaticcio, but that it is really his appears very doubtful.

At present, this noble building is by no means in a satisfactory condition. It belongs to the Comte de Chambord, by some known and hopefully looked up to as Henry V. of France. His portrait hangs up in the little but excellent inn adjoining the palace, the only habitation, except a religious house, which obtrudes on its desolation. On my pointing it out to the hostess, she referred to it with an evident expression of hope, and looking forward to better days to come, and only answered my doubting remarks by saying—"Ah, Monsieur, au bon Dieu, toutes les choses sont possibles."

In 1793 it was despoiled internally, and greatly defaced externally; and the domain being about to be sold, and the castle broken up, in 1821, it was purchased by the people during the reign of Charles X., and presented to its present owner. Its situation is the very reverse of picturesque. It stands in a flat country, three or four miles from the banks of the Loire, and in just such a monotonous position as Wolsey, at about the same epoch, chose for his palace of Hampton Court. The fossés which anciently surrounded it are now filled up, but can be easily traced; its last resident was King Stanislaus of Poland,* whose apartments are still preserved in a habitable state, but all the rest of the building is utterly stripped of all internal fittings, and presents a scene of perfect desolation and departed grandeur, to which may almost literally be applied the touching verses of Hood—

No dog was on the threshold, great or small,
No pigeon on the roof, no household creature,
No cat demurely dozing on the wall,
Not one domestic feature.
No human figure stirred to go or come,
No face looked forth from shut or open casement,
No chimney smoked, there was no sign of home
From parapet or basement.

Ducerceau, who wrote as an old man, about 1560, thirty years after the building was erected, speaks of it thus:—

"La commodité du dedans a esté ordonnée avec raison et sçavoir. Car au milieu et centre est un escallier à deux montées percé à jour et entour iceluy quatre salles, desquelles l'on va de l'une à l'autre,

* 1725.

en le circuissant; aux quatre encoigneures d'entro chaque sallo y a un pavillon, garny de chambre, garderobbe, cabinet et montéo. Plus és quatre coings de la masse de tout lo bastiment se voyent quatre grosses tours, garnies à chascun estago de toutes commoditéz, comme chambre, garderobbe, privéz, cabinets et montée.

Notwithstanding what Ducerceau says about the commodité of Chambord, it is extremely difficult to understand how any comfort could have been found in it; all the large rooms being given up to the guards, and the remainder are very small, scattered, ill-contrived, and reached by long galleries or open staircases. Blois is much the same, but the principal rooms are of greater dimensions, and certainly better arranged. Chambord was a very favourite residence of Francis I. When the works executed during his reign were well advanced, it was visited in 1539 by Charles V. of Spain, when he traversed France; and in the declining days of Francis, it was much resorted to by his sister, the Queen of Navarre, whom Francis called his Marguerite des Marguerites. It continued to be occasionally resorted to by the French monarchs, and particularly by Louis XIV, who first came here that he might conceal his royal amours from his mother the austere Queen of Austria. The grand monarque visited the chateau for the last time in 1684.

Alfred de Vigny, in his novel of Cinq Mars, describing this building, says:—"on conçoit à peine comment les plans en furent tracés et dans quels termes les ordres furent expliqués aux ouvriers, cela semble une pensée fugitive, une idée brillante qui aura pris tout à coup un corps durable, un songe realizé." And another more recent writer, not less enthusiastic, says:—"quelle qu'ait été la pensée qui a enfanté Chambord, elle a sans contredit créé la Merveille de la Renaissance, cette époque qui a fait surgir du sol Européene tant de prodiges n'a rien inventé, rien laissé de plus beau et de plus saisissant." And another old writer says, the Palace of Chambord, "est bien le plus merveilleux en toutes piéces rares qu'il y ait en Europe, et comme abrégé de toute l'industrie humaine de son temps."

On a smaller scale than either of the preceding, is Chenonceaux. It was built by one Thomas Boyer, chamberlain of Louis XII, who following the example set by Francis I, sometime after 1496, when he bought the estate, built the present chateau, or rather commenced it, for he died in 1523, leaving it unfinished; after which it became a royal palace, and the property of Francis I, who frequented it often with Catherine of Medicis. By Henry II. it was given to Diana of Poitiers, who rebuilt the principal façade, and constructed the elegant gallery over the river. This gallery is called the Salle des Gardes, but is said to have been built by Diana of Poitiers to communicate with the left bank of the river, "ou se trouvait un Sylvestre et plantureux boucage arrosé de fontaines et verdoyant comme un pré d'avril." On the sudden death however of Henry II, and the advent to power of Catherine de Medicis, Diana of Poitiers was obliged in 1560, to exchange the chateau for that of Chaumont, near the Loire. This same year, our Mary Stuart visited Chenonceaux. Catherine retained this chateau until her death in 1589, when she bequeathed it to Louise of Lorraine, wife of Henry III. Chenonceaux is a simple building in its form, as indeed all the buildings of that time are. It is a parallelogram on plan, with a chapel annexed on one side, and the great wing extending over the river at the back. The chapel, like that at Ecouen, is built in what appears to have been the conventional ecclesiastical style of the day, very similar to the church of Saint Eustache, at Paris. The principal façade is rather more massive in its treatment, the cornice more strongly marked than those at Fontainebleau and Blois. There is a round tower at some little distance in front of the chateau, but unconnected with it; it is of the same date, but its use as part of the building is quite problematical, unless it were, as at present, a lodge to the main building. This chateau is now private property, but may be seen even when the family is in residence.

I may cite also the Chateau of Anet, now demolished, which was the work of Philibert de l'Orme. In this building every resource of Art was used to produce a perfect work. And the small portions which remain attest a great refinement, a marked advance on the works of Francis I's. reign, and much elegance of design. The interior of the apartments were covered with panelling, executed with extreme care and richness under Jean Goujon, and the painted windows were the work of Jean Cousin.

Before Philibert de l'Orme had completed Anet, Jean Bullant was employed by the Constable of Montmorency to build the Chateau of Ecouen; this is a fine work, but the architect in some portions has been too anxious to copy the antique servilely, not accommodating it, as had been done so well in some of the other buildings I have referred to, to the feudal form of building to which it is applied, and the steep roofs which surmount it. On this work, amongst other distinguished artists, Bernard of Palissy, is said to have been employed. Ecouen is about six miles from Saint Denis; it is now used as a seminary for the daughters of the members of the legion of honour, and is not accessible to the public.

I may also here refer to the old façade of the Hôtel de Ville at Paris, a well known example of the era of Francis I. Ducerceau, who wrote during the Regency of Catherine de Medicis, towards the latter end of the sixteenth century, enumerates and gives plates of no less than eighteen Royal Chateaux: Blois, Amboise, Villiers Costerets, Charleval, Les Thuilleries, Sainct Maur, Chenonceaux, Le Louvre, Vincennes, Chambourg, Boulongne dit Madrit, Creil, Coussy, Folembray, Montargis, Sainct Germain, and La Muette. Writing after the wars of Francis I. and his successor—the very wars which appear to have imbued the French monarchs of that time with their love of splendour, he says, "J'ay pensé ne pouvoir mieulx à propos mettre en lumiere ce premier Livre des Bastimens exquis de ce Royaume: esperans que nos pauvres François prendront, peult estre, en respirant, quelque plaisir et contentement, à contempler icy une partie des plus beaux et excellës edifices, dont la France est encores pour le iourd'huy enrichie." Of these some are of early date, and several are now gone—swept away chiefly by the ruthless hands of the destroyers during the anarchy of the French revolution. The Chateau of Madrit, built for Francis I. by Pierre Lescot, 1540 to 1550, must have been a very noble example; some of them, as the Chateau of Chantilly, have still an enduring name; of some, as the Chateau of Gaillon, built for the Cardinal d'Amboise by Fra Giacondo, a Venetian architect, and the Chateau of Anet, to which I have already alluded, fragments are preserved in the court-yard of the Ecole des Beaux Arts at Paris; and of some I have this evening offered you a more full account.

In considering these fine monumental palaces, perhaps one of the most striking features is the staircase. It was a feature which had received considerable attention from the later Mediæval architects. All of them are constructed on the principle, no doubt derived from the earlier turret staircases, of a central newel. There is a well known instance in the Flamboyant style of a beautiful wooden staircase leading to the organ gallery at the Church of Saint Maclou, at Rouen, and another, not perhaps quite so well known, but which is a most elegant and elaborate effort both of taste and construction, a stone staircase in a house situated very near to the Cathedral of Strasburg, the design of which, with very excusable gallantry, is attributed to the daughter of the architect of the mighty cathedral; it is a work indeed requiring the utmost precision and nicety of constructive skill, whilst it is exuberant in fancy and decoration. We have also the two staircases of the Corps de Logis of Louis XII, and several other examples might be cited. The staircases of the chateaux we have been considering, are, however, generally of larger proportion than the earlier works referred to, and at Chambord the architect has indulged his taste by building no less than thirteen staircases. One of the noblest external staircases with which I am acquainted, I believe the very noblest, is that at Blois; the spiral turn of the stairs is adopted as the

leading feature of the design, to which all the rest is subservient; and whilst there is considerable massiveness and solidity of construction, the octangular form of the building and the inclined lines of the staircase intersecting give a remarkable playfulness to the design, and the great beauty of the sculptured decoration adds that prevailing grace which is one of the chief characteristics of the architecture of this epoch. The central internal staircase at Chambord, circular on plan, is also a very fine work; it is of considerable size, being thirty feet in diameter, and there is a double flight, one under the other. The central newel is not absolutely solid, there being a hollow core, which extends from the ground level up to the upper part of the beautiful central turret of the chateau. The double flight ceases at the level of the terrace, and a single flight continues to the upper part of the central turret. The decoration of the staircase is admirably carried out, the various capitals of the flat pilasters, adapting themselves to the horizontal and inclined lines of the entablature which they support, are all beautifully wrought. The angle staircases in the court yard, of a somewhat later date than the central staircase, surrounded with open colonnades and crowned with dome shaped roofs, surmounted by the fleur de lis, are also elegant compositions.

Certainly however the great feature of all these buildings is the roof. Ruskin has remarked, that the first and most characteristic feature in a building is the roof—that the first ingredient of a habitable building is the roof—and it has long been observed how distinctive a feature it is—and how, as a general rule, its inclination may be taken as a proof, if I may so express it, of its original geographical position. Now, in this country and in France, in the later times of Mediæval architecture, the roof took a very different growth; with us it grew flat, in France and Germany it grew high and steep. Rickman observes, in his "Styles of Architecture," that in our late Gothic, one of the distinguishing features is the embattled parapet. The roof had at that time so generally become flat, that some relief and finish to the wall, and indeed, some breast-work or protection to those using it were required; and they copied the parapets of our castles, retaining by tradition, and probably for more richness of effect and diversity of outline, the battlement also; which became so indispensable a feature with our late Mediæval architects, that they introduced it, as a decoration even on the transoms of the windows. Together with the four centred flat arches they used the flat roofs, and with the flat roofs embattled parapets, and the church towers were built without spires, and finished also with parapets.

Now in French Flamboyant, that latest and, to my mind, very beautiful school of French art, the proportion became more elongated; the flaming of the tracery influenced the upward growth of the building; the lofty narrow window also caused it to grow in height, and the roof grew with the rest of the building; and particularly on the tower, when spires had also fallen into disuse, the roof assumed almost the inclination, if not the place of the spire, and the conical roofs to the circular angle turrets were in fact true spires, but being somewhat less elongated in form retained the character of roofs. The roof with its over-hanging eaves and the cornice which supported it, rendered the parapet unnecessary as a matter of ornament; and as the roofs were inaccessible except by means of ladders attached to the projecting hooks which we so commonly see on the steep roofs of French buildings, the parapets were also unnecessary as a matter of use, and thus in French late Mediæval work, the parapet is of very rare occurrence, indeed I do not remember any example of it. I allude rather, however, to these features of French architecture, because it seems to explain the tendency to high roofs, which to this day prevails in French architecture, and although they are incongruous when applied to strictly classical architecture, yet they are not so in connection with the particular style of these chateaux, and the extreme picturesqueness which they give wherever they are applied is quite a sufficient reason for their being maintained, and an inducement to harmonise the lower part of the

building with the lofty roof, an effort to accomplish which is readily to be observed in many modern French buildings; and, indeed, all that appears necessary to attain this is to develope the predominance of the upward lines of the decorations, and to suppress the importance of the cornice, which in buildings where the roof forms the crowning ornament is not of the same importance as in classical buildings, where the roof is a very subordinate feature; and recurring to Ruskin's observation that the roof is the great feature of any habitable building, the architects of the French Renaissance would appear to have been fully imbued with this principle. I may, before leaving this part of the subject, observe that although the Italian architects employed at Fontainebleau had introduced and practised a correct proportion in drawing the human figure in the mural and other decorations in this school of design [for such Fontainebleau then actually was] the French artists, influenced by the traditional feeling of the Flamboyant School, actually elongated their human figures, and allowed this tendency to give a marked character to all their works.

Although in the buildings of the time of Francis I. there is a very evident reference to the revived schools of classical architecture, still there is no servile copy; indeed, there is no part of the decoration in particular which does not, more or less, bear a very distinct and separate character from its type. The proportions of all the mouldings of the cornices and string courses at Blois, Fontainebleau, and Chambord, are very much exaggerated, as in Prout's drawings; they are all coarse, and but rude copies of the best Italian work; there is however a great vigour gained by this treatment, and the peculiar cornices of Chambord and Blois, although not to be compared in elegance with Italian work of the same time, yet have a rude and massive character which gives considerable dignity to the work. The projection of the pillasters is small; the arch mouldings and architrave mouldings are generally delicate and of better profile than the main cornices and string courses, and the decoration of the capitals and carved panels is of a character often of extreme delicacy, and always of great and peculiar beauty, and there is an exuberant fancy in their varied design. The representation of foliage is perfect, and the best adapted for architectural decoration of any school of art. Cyphers and emblems, figures and animals, are sometimes introduced, but the animal carving does not equal the flowing racy vegetable form of the foliage, and at Chambord it is certainly very inferior.

The buildings of this age are very much ornamented with the emblems and cyphers of their owners; a practice indeed, which, as to the cyphers, has been continued in France to our day to an extent much beyond what prevails amongst us. The F for Francis, surrounded by the Cord of Anne of Britany, and the Salamander his emblem, and sometimes his motto "Nutrisco et Extinguo," are common on all the works of his period, whether they are Renaissance as at Blois, or Flamboyant as in the transepts at Beauvais. H for Henry, and his emblem the Crescent, also the emblem of his mistress, which he did not scruple constantly to use on the buildings of his reign: at Chambord, indeed, no opportunity seems to have been lost of displaying the royal H and the Crescent interlaced, also the two D–D connected forming H and D, and at Fontainebleau they are even used in the chapel. The Porcupine was the emblem of the ancient house of Orleans; the Ermine of the house of Britany; une Cordelière, of Queen Anne of Britany; and the S with a Dart through it was the emblem used for the name of the mistress of Henry IV. Gabriel d'Estrees.

I might allude to other points of interest, and draw some comparison with our own palaces of somewhat similar character but of later date, and remark on the number, great extent, and magnificence of the royal domains I have so inadequately referred to; the use of which, even in imagination, never seems with us to have been contemplated except in the one instance of Whitehall, of which we possess so noble a fragment. But I now conclude, having accomplished the object I had in view of briefly calling to your mind the memory of a well defined and highly interesting class of buildings.

Mr. Mocatta, Fellow, confirmed the remarks of Mr. I'Anson as to the extreme care bestowed by Louis Philippe on the restorations of Fontainebleau; the cost of such restorations and their extraordinary magnificence being perfectly astonishing. The splendour and magnitude of the great French Chateaux gave a peculiar interest to the national history of France, and contrasted forcibly with the comparatively small and insignificant edifices of the kind of this country.

Mr. Fowler, Fellow, had received a very favorable impression of the works at Fontainebleau, which he had seen in active and satisfactory progress, in the year 1841. In carrying out the train of associations excited by the contemplation of such works, it was impossible not to observe that whilst both Louis Philippe and the prespet Emperor of the French had expended very large sums of money, from their own resources in addition to those of the nation, upon these restorations, yet the works were not suspended when the reign of Louis Philippe came to a close, but were in full progress under the Republican form of Government; a fact which must be considered highly creditable to the national character.

Mr. I'Anson, in reply to an inquiry as to the irregularity of plan in the Château of Blois, said that it had been founded upon an older building. He understood that the restoration of one wing at Blois had cost £ 16,000.

Mr. A. J. Baker, Associate, suggested that it might be desirable, in the present practical age, to obtain information as to the exact reasons which had led to the adoption of the extremely high pitched roofs, which presented so remarkable a feature in the chateâux in question.

Mr. Parris, Visitor, called attention to the decorations of Fontainebleau, and especially to the frescoes by Primaticcio. When the restorations were commenced there, it was stated by French artists that these works would not resist the action of damp; and he, Mr. Parris, went over on purpose to ascertain the fact. He found that the roof had been completely off, and the wet had penetrated and burst the plastering off the walls, which was lying down split in all directions. He picked up several pieces, and found that the colouring was as perfect as when it was first executed,—the plaster having merely been thrown from the wall, but the paint not detached from the plaster. Several experiments had been made with a view to the restoration of the paintings, and the result was that they had been restored with a wax medium, none of the fresco being left. It appeared clearly that it was not the fresco, but the plaster which had failed, by the damp getting behind it; and, with regard to the general question of the permanence of fresco painting, it was satisfactory to know that our plaster was as good as any of that of ancient Rome, and certainly superior to that employed at Fontainebleau. Wherever the walls of a building imbibed moisture from the air, or from the ground, the plaster was liable to be thrown off. This had taken place in ancient Roman buildings, where the lower parts of the frescoes were damaged.

Mr. J. G. Crace, Visitor, observed with reference to Chambord, that he had always thought it could only have been constructed as a place for conviviality, and for the assembly of a large number of persons in the hunting season in one large hall; the other apartments being all of small dimensions, and adapted only for bed chambers. Mr. Crace adverted to the peculiarly curious arrangement of the double spiral stair-case in the centre of this château. With regard to fresco, he had known instances where the action of damp in the atmosphere had affected the colouring and quality of the plaster. In London, he imagined the lime would attract the smoke, and that in forty or fifty years the pictures would become blackened by absorbing the carbon of the atmosphere, and certainly would not present so good an appearance as those painted in oil, encaustic, or any other vehicle, whilst the dead appearance of fresco might be obtained, if desired, by adopting a proper medium. He considered that polychromy had been very successfully applied to the exterior façade of one part of the Château of Blois, a portion of which was shewn in one of the drawings.

Mr. I'Anson, called attention to a number of black lozenge-shaped ornaments on the exterior of the chimney shafts at Blois. These were singularly effective, though very simple, being merely pieces of slate fastened to the stone work, and not, as they appeared to be, marble inlaid.

Mr. Foggo, Visitor, said that Mr. Parris in using the term *plaster*, had adopted the expression which had led the French artists astray. Sulphate of lime was not the proper vehicle for fresco, nor would it endure at all. With regard to the vast expenditure of the French monarchs, it should be remembered that Francis I. lost a battle and his liberty because he was unable to pay his army; and that Louis XIV. brought France to the brink of bankruptcy. A little more discretion, judgment and good taste, might have enabled these sovereigns to do as much good to architecture, and to benefit the nation still more.

Mr. Parris thanked Mr. Foggo for his correction. By fresco, he meant paintings on plastering formed of pure lime and sand.

The Chairman, Mr. Godwin, Fellow, proposed the thanks of the meeting to Mr. I'Anson. It was pleasant to see that gentleman returning, after a lapse of ten years, to a subject he had already illustrated, and with as much ardour and vigour as before. He (the Chairman) would only caution the meeting against adopting literally the enthusiastic phrases of the French authors quoted by Mr. I'Anson; for although Fontainebleau and Blois were exceedingly picturesque and interesting when seen at a distance, they would be found weak in detail upon close examination, and not to be compared with the Gothic edifices upon which their outline was evidently founded. The subject of external polychromy was always interesting, and the recent applications of it in Regent Street by Mr. Owen Jones, and in Tottenham Court Road by Mr. Lockyer, together with other instances, proved that a strong disposition existed to apply it to modern architecture.

After the thanks had been acknowledged by Mr. I'Anson, the meeting adjourned to the fourteenth of January, 1856.

REMARKS ON THE FORMS, METHODS OF CASTING, AND RINGING OF LARGE BELLS, WITH SOME SUGGESTIONS ON THE SUBJECT.

By C. H. Smith, Honorary Member.

Read at the Ordinary General Meeting of the Royal Institute of British Architects, Jan. 14th, 1856.

The subject for consideration this evening is rather of an unusual kind, and one in which I am by no means deeply versed. But amongst the company present I observe many gentlemen eminently distinguished for their attainments in physical science; I therefore depend on the acuteness of such members and visitors in detecting errors, should I be wrong; and on their candour, in admitting my observations, if right. In fact, I wish the subject to be thoroughly discussed, and only to be allowed myself to act as one of the speakers.

I am aware of the old saying, that "it is much easier to find fault than to suggest a remedy;" this is perfectly true in the present instance. I feel assured that the long established system, connected with the manufacture and use of large Bells, is attended with many serious inconveniences; and that a vast opening for improvement exists, whether we regard the form, the mode of casting, or the usual method of ringing them. And although I can confidently point out difficulties and objections, I candidly admit that I am not prepared to offer positive improvements or remedies. There is scarcely a bell tower in the kingdom, which is not shaken to a certain extent, and the masonry disturbed; in some cases fissures of a dangerous character are formed from top to bottom; in others the ringing is altogether discontinued for fear of the oscillations bringing down tower, bells and ringers to the ground in one common ruin. If any one will seriously consider the operation of raising a body weighing ten or fifteen tons (a weight greater than any stone used in the erection of the British Museum, the Post Office, or the Royal Exchange) to the elevation of 150 or 200 feet from the ground; and, when so raised, whirling it in the air until the arc of oscillation becomes a complete circle; then, in addition to the simple gravitating weight, make a calculation of the centrifugal force in ringing, he will only be surprised that the towers and the buildings adjoining them are not more frequently destroyed by such violent proceedings.

Mr. Ferrey, who has had frequent opportunities of becoming acquainted with the subject, has written to me as follows:—

"You wish me to state what I have observed in the towers which have come under my professional notice, as to the effect of the mode of bell hanging hitherto adopted. My remarks apply rather to the bad consequences arising from neglect or ignorance, than to the principle upon which Bells are generally hung in towers and campaniles, in the frames technically called cages. Still, if some plan of bell hanging could be adopted less liable to derangement than the framework commonly used, much mischief to church towers might be avoided.

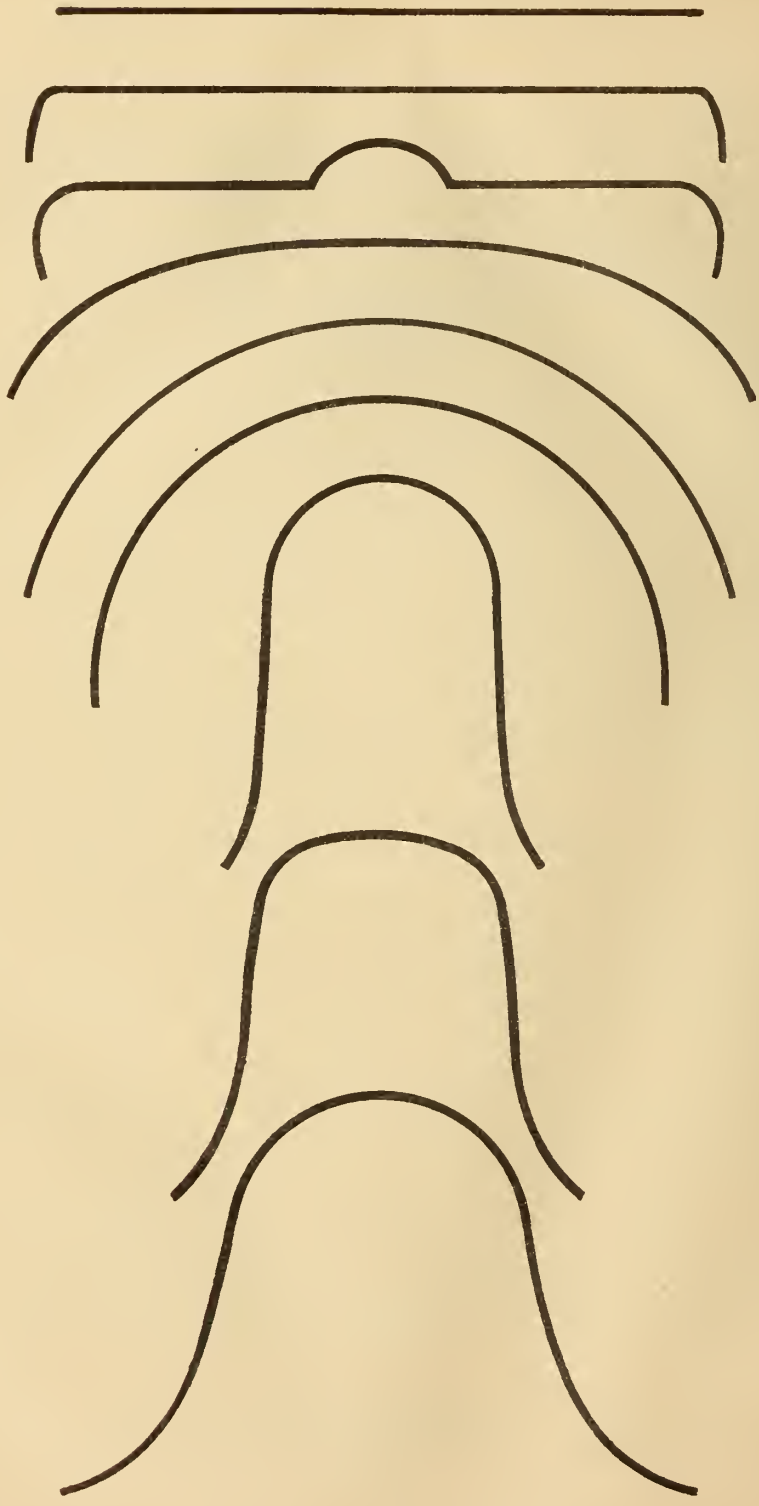
"In the course of my examination of many ancient churches, I have frequently had to deplore the serious injuries caused to the towers by the action of the bells. However judiciously they may be arranged within the framework, there will naturally be some unequal strain upon parts of it; no sooner do the ringers find a difficulty in raising the bells, owing to the want of a proper bearing on the gudgeons, than they immediately begin wedging up the framework of the bells from the walls, window mullions, or any masonry nearest to the point where the bell which works heavily is placed; no attempt is made to brace the woodwork and so remedy the defect, but in order to

prevent further spreading, struts and wedges are placed between the framing and the walls of the tower. With a heavy peal of bells the disastrous effects of this slovenly system must be obvious; the great vibration arising from the revolution of the bells is at once thrown upon the walls, and the damage resulting from it becomes very soon apparent. Our ancestors meant to avoid danger from this cause, and I do not know an instance of any importance, where the tower walls are not provided with ample set-offs and brackets on which the old bell framing was placed perfectly free from the surrounding walls, and generally with a space sufficiently wide for a person to pass round the bells; the whole framework resting upon these set-offs as a dead weight only, no timber of any kind being inserted in the walls. If this plan was properly respected, and the framework carefully kept free from the walls, much structural injury might be prevented; but even then the oscillation which occurs must eventually damage the building. I have been in old towers while the bells were in full peal which have *rocked* to such a degree as to cause me alarm, and the quivering vane, and tremulous motion of other parts have given full proof of the extent of the vibration. In some central towers, I have observed much injury to the supporting arches and piers; as in the case of the tower of Othery Church near Bridgewater, the structure was rendered dangerous by the manner in which the tower piers were split and crushed by the action of the bells. In many instances, the belfry chambers are closed against the ringers, and the bells are only permitted to be *tolled*, owing to the dangerous condition of the towers. Very recently steps have been taken to rebuild the upper part of the spire of Bellbroughton Church near Stourbridge, the masonry of which was so loosened by the vibration of the bells, as to become quite dangerous. I could mention many other instances which have come under my notice of the serious results arising from bad bell hanging, and ignorant attempts to remedy the evil, but I have no doubt that other professional men will supply you with examples. I hear that you are proposing some new form of bell, by which the same musical tones can be produced, without the necessity of their being put in such violent motion. If you succeed in this, and can give us the same joyful effect without the necessity for cumbrous wooden framework and risk to the buildings, you will have effected a very desirable object."

I may also call your attention to the following, remarks by the Rev. W. C. Lukis, in the Wiltshire Archæological Magazine:—

"It is a matter for our grave consideration, how it comes to pass that so many of our village churches should have their towers in so dilapidated a condition. I have seen several in the course of my Wiltshire rambles, which are in so dangerous a state that the bells are forbidden to be rung. There can be no doubt that this arises from two causes. In the first place, bells for which the towers were originally constructed were not subject to the same revolutions and tossings as now. They were swung to and fro, it is true, but very gently compared with the present wild summersets of change ringing, an art of comparatively recent date. Consequently, in constructing the towers, the architects of those days had not to take into their calculation the great vibration of the walls produced by the violent motion of the bells. In 1810, the spire of St. Nicholas' Church, Liverpool, fell as the people were assembling for service, and killed twenty-three persons. This catastrophe was partly caused by the vibration of the bells. Any one who has stood in the belfry of the lofty and beautiful tower of Magdalen College, Oxford, when a peal is ringing on its ten sweet-toned bells, knows the way in which a tower is made to sway. To a person of weak nerves it is perfectly alarming, and it is easy to understand how this kind of vibration must loosen the masonry, and eventually endanger the building."

That the process of throwing bells up and down is inconvenient as well as dangerous is proved by the fact, that nearly all large bells are struck on the outside with a hammer, instead of being



OUTLINES TO ILLUSTRATE
MR C.H.SMITH'S PAPER ON THE FORMS &c. OF BELLS.

whirled round; either because the tower is in a dilapidated state, or that too many men are required to raise the bell, if it is to be rung according to the original intention of the machinery.

The most sonorous material for bells is found to be a mixture of copper and tin in certain proportions, generally four parts copper to one of tin. It is an error to suppose that silver enters largely into the composition of some bells, though the recently discovered metal, aluminum, is said to be very sonorous. The greatest care is requisite during fusion not to heat the materials more than absolutely necessary; and when melted and sufficiently hot, to commence casting them with as little delay as possible; for metals in a fluid state may be distilled or sublimed by heat like other liquids; consequently, the tin being melted at a much lower temperature than the copper will be driven off in a sort of aeriform or vapourous state; therefore, in order to be certain that, when the bell is finished, it shall contain the proper quantities of each metal, great importance must be placed on putting in the tin at a proper time, or when the cast is completed, its composition will be different in its proportions from what was intended; this will, of course, alter the sound, and very likely render the bell less sonorous. If the bell is to be a large one, the metal must be fused at several furnaces, varying in intensity of heat, and some ready for the mould before the others; but wherever two or more currents of fluid metal meet, the rudiment of a fracture may be formed, as the chances are, that portions of oxide, or earthy matter, floating on the surfaces, may prevent the perfect junction and incorporation of the two streams.

It is a common practice to pour hot metal into a cold mould, or into a mould that has been warmed on the surface by pouring a small quantity of the fluid metal into it, and then, by some contrivance, letting this metal run out again before it has had time to become solid; this plan will give a momentary warmth to the surface of the mould, or perhaps may warm it to the depth of half an inch, but it will not prevent the hot fluid metal when poured in from becoming solid wherever it touches the mould, while the interior of the mass will still remain in a liquid state. Under such circumstances, the cast will be tolerably fine-grained, solid and compact, where the metal has first cooled, that is, wherever it has come in contact with the mould; but inside, where the fluid metal has not been so immediately cooled, but has remained longest in a melted state, the texture will be open, coarse-grained, porous, and highly crystalline.

If it is the general opinion, that no better form* for bells can be introduced than that which has been in use for ages, namely, the various modifications of a hollow cup-shape, we must endeavour to find some mode of improving the contour, and process of manufacture; so that cracks in the bells, and destruction of the towers, together with many other vexatious incidents, may be much less frequent than heretofore. Whatever the general external and internal form of a bell may be, the plainer the surfaces the better will be the sound; all moldings, inscriptions, dates, and every kind of ornament, whether projecting or indented, should be avoided; as they interrupt the free vibration of sound, in proportion as the relief is high or low; and are therefore worse than useless on an object that is intended to please the organ of hearing, infinitely more than that of seeing. A small bell finished in a lathe will sound better than one rough from the mould.

To produce sound, bells are usually struck by a clapper within, or by a hammer on the outside: such continued battering upon a cast, or crystalline substance must, sooner or later, crack the metal. This may happen when the bell is quite new—soon after it is placed in the belfry—or not for several centuries. A number of comparatively insignificant hammerings, or concussions, will produce a very surprising effect, if continued for a long period. The fracture may,

* See diagram showing the forms which have been used, from a flat plate of metal to the complex ogival bell. The paper was also practically illustrated by experiments.

at first, be so trifling as to be almost inappreciable by the most refined ear; but every stroke of the clapper will increase the evil, until the vibrations of the metal are so interrupted that, instead of a long continued harmonious sound, an unpleasant jarring noise is produced, and the bell becomes useless. Mr. W. L. Baker's plan, proposed in his paper on bells read here last year, of gradually turning the bell round, is a great improvement.

The loudness of a bell will depend upon many circumstances in addition to its magnitude, weight, or the violence with which it may be struck. A calm and frosty atmosphere is favourable to the transmission of sound; violent winds and other ærial agitations interrupt its progress. When a strong wind blows from the hearer towards the sounding body, a sound often ceases to be heard, which would be distinctly audible in a calm.

Various circumstances have led me to consider whether a totally different form from that usually given to bells might not be introduced with advantage. Large blocks of stone are sometimes accidentally placed so that they balance on a small lump, immediately under the centre of gravity: while in this position, if they are struck with a heavy piece of wood, a deep, sonorous tone is produced. On the same principle, a number of long strips of hard stone, of different sizes, are hung on two tapes, forming a rude instrument called the "Rock Harmonicon," which, when struck with a soft hammer, produces very harmonious sounds. Clappers and hammers are generally too hard; vibration is required, not harsh collision.

Solid masses of metal, formed in a particular shape and suspended in a certain way—when struck with a hammer, will give very melodious sounds. For example, suppose a perfectly sound lump of soft steel be forged in the shape of a spindle, or of two cones of the same diameter, but of unequal heights, and united at their bases,—each cone bearing a relative proportion to the other, either in its cubical contents or superficial area,—the larger one to be three, four, or five times the size of the smaller,—suspend this at the largest diameter, or nodal part, by two pins or trunnions, and strike it with a hammer near the centre of gravity of the whole mass,—it will vibrate freely, and give a long-continued musical sound. Or take two pieces of metal, formed precisely of the same shape and dimensions as the last, one of soft steel, the other of bell-metal, and suspend them in a similar manner,—if these two be struck at the same instant, either with a hammer, or against each other,—care being taken that the striking point is near the centre of gravity of each,—the sound will be a loud, musical chord, of a very harmonious kind.

Different experiments lead to the inference, that coarse-grained, crystalline substances are not so sonorous and fit for the transmission of loud musical sounds, as those which are of a closer and more compact texture. Glass is extremely sonorous, and the sweetest tones may be produced from it. For this reason it is probable, that if, instead of fusing and casting them, bells could be manufactured by hammering the metal into the requisite form, the same intensity of sound might be obtained from a much smaller quantity of it. Of course the manual labour of beating a ton of metal into the required shape would be very considerable; but if one ton of beaten metal could be made to answer the purpose of four tons, melted and cast in a mould, there would be a saving of at least £300. in the cost of the material, which sum would be more than sufficient to pay for the hammering; and a bell so formed could not easily be cracked, nor would the tower be so heavily laden. The well known Chinese gong is, generally, an instrument remarkable for its rudeness of manufacture and thinness of hammered metal, but when struck with a soft hammer, it gives a deep bass tone, louder than can be obtained by any other means from the same quantity of metal.

I am prepared to hear it stated, that some of the sounds to which you have been listening may be very satisfactory on a small scale, and suitable for the interior of moderate sized buildings; but

for high towers in cities, or open countries, such contrivances would be almost useless, being scarcely audible at the distance of 50 or 100 yards. I have my doubts as to the correctness of these objections, especially to such as have not been fairly verified by experiments on a large scale, and thereby proved to be failures. The sound of some musical instruments, the harp, for instance, is not over-powerful in a good sized room, and not louder than a pianoforte, or violin, when in concert; yet, during a quiet evening, or early in the morning, its melody may be distinctly heard at a much greater distance, and long after other instruments have ceased to be audible. The same remarks are applicable to the beat of a common military drum, which is distinctly heard at an immense distance. Two pieces of metal, of a sonorous kind, one, probably, only half the weight of the other, but of the same form and proportions, will give the same, or very nearly the same sound. I show the experiment, which is a curious fact, though I am not prepared to explain it. Taking this latter and many other circumstances into consideration, it must be evident that the entire subject should be thoroughly investigated; especially at the present time, when we have a grand building at Westminster nearly completed, with a clock-tower waiting for its bells, one of which is to weigh 14 or 15 tons, and the prime cost of the metal only for this one bell cannot be estimated at less than £1,700. When I hear of a work of this kind progressing in the middle of the nineteenth century without any improvement on the old system, I feel that the credit and character of scientific men is involved in the transaction. For, if they would turn their attention to the subject, it is not only possible, but extremely probable, that some plan might be discovered to answer the purpose of these ponderous bells, with perhaps half, or one-third of the quantity of metal, much less risk and difficulty of ringing, much less weight in the tower, and much more credit to all parties concerned in the great work.

In conclusion, I beg to make the remark, that a long habit of considering an established practice as not wrong, gives it a superficial appearance of being right. I am therefore afraid that popular prejudice, in favour of the old system of bell-founding, would be such a formidable barrier against improvement, that no innovation would be tolerated, except by almost imperceptible gradations. As far as the subject of this evening is concerned, it matters not whether large bells are the legitimate offspring of the Christian Church, or whether they are a remnant of Paganism. It is certain that they have been used in various parts of the world during the period of at least 500 years, perhaps double that time, with scarcely any alteration in their shape or composition. So tenaciously has the form been adhered to, that a common observer might imagine it to be heresy to think of making an alteration: it would almost seem that the shape and process of manufacture might be considered of too sacred a nature to be departed from, after having been practised for a thousand years.

Were I to present a peal of six or eight large spindles, or double cones, such as I have described, to be suspended in the bell tower of the new Church at Hanwell, I might expect to be sent after them to the neighbouring Asylum, for supposing that the churchwardens or bell-ringers were clever enough to ring the congregation to church with what might be mistaken for the clappers only. But surely, in these days of invention, when we live, as it were, in an atmosphere of steam-power,—when our words are sent, almost as quick as we can utter them, to the further end of a wire hundreds of miles in length,—when the portraits of living creatures, topographical views, or other complicated objects, can be produced in an instant by a flash of light, with such truthfulness and minute accuracy as to defy microscopic criticism,—it cannot be too presumptive to expect that, after a lapse of many hundred years, with the help of philosophic investigation, and mechanical science, we should be able to suggest some modification between the old ponderous bell and the thin, loud-sounding gong,—between the sweet notes produced by a musical snuff-box and the spindle-shaped steel which I have exhibited this evening. I will therefore conclude with the hope that some hints may be taken from

my remarks, and that the discussion, which I trust will now follow, may lead to such experimental investigation as may ultimately change the present inconvenient, dangerous, and expensive system of Bell-ringing.

Mr. C. Barry, Fellow, said that the thanks of the meeting were due to Mr. Smith for bringing forward not only the subject of the casting of bells, but also points which were useful to them as architects; and especially the question of the degree of strength necessary for bell towers. If, as Mr. Smith stated, the mode of ringing bells was different now from that formerly practised, and if this mode were to be persisted in, it became a matter of importance to regulate the construction of bell towers accordingly. The comparative merits of cast and wrought metal for bells opened a wide field for interesting investigation. The peculiar sound of the gong was very remarkable, but it appeared to him that it had much less penetrating power than that of a large bell. It was, however, very difficult to arrive at conclusions on such a point, as the effect upon the ear of different individuals would vary. Thus, when Mr. Smith in some of his illustrations had assumed that there was no difference between certain sounds which he had produced, he (Mr. Barry) had thought there was a considerable difference. He hoped the subject would elicit much valuable information from gentlemen present who were peculiarly qualified to impart it.

Mr. Cornelius Varley, Visitor, said the subject of bells divided itself into two parts; one, how to obtain a good bell and the fullest sound with the least weight of metal; and the other, how to support the bells and obtain the most of their sound with the least injury to the building; this was the architectural part. With respect to swinging of bells, Mr. Smith was right; whilst swung in open space there was no increase of sound, but it varied as the mouth was swung to or from the auditor. This opened the architectural question, for whilst the bell hung quiet it presented its best sound to the rough floor of the belfry, and spread it round into the corners, all serving as dampers, and a portion rushed out of the openings, where it was again cut up by the weather boards. A bell so smothered by the enclosure need to be much heavier, because we obtained but a portion of its sound; but if the bell was swung (though there was no increase of sound), it alternately presented its mouth to the two opposite openings, at which moments a larger portion of its sound was thrown out, and the discordant effect of its enclosure lessened, and thus by swinging we only lost less of the sound; but this swinging was communicated to the tower, and were it not for the discordant proportions of all the parts, a spire would be seen to vibrate, and all the parts trembled. The late Mr. W. Hardy contrived an inverted pendulum to show whether chronometer supports were firm enough; and it shewed that many swung right and left with the pendulum, and so prevented any very accurate adjustment. Bells being so much heavier than pendulums will rock their tower, and Mr. Hardy's instrument could be adopted to show it, and probably would prove it to be more than any important building ought to be subjected to. An architect, having produced a handsome building to endure the roughest weather, ought not to be required to spoil its proportions by any increased bulk to make way for and support a hidden agent, whose action was so inimical to durability. If bells were hung in the open air, over the conical roof of a tower or support suitably constructed for such moving weight, the cone below would spread their sound right and left; and if their cover were a large sounding board, we should obtain the most effect from a given weight of metal. With regard to sound and smooth bells, he had witnessed the full effect on the occasion of Lord Macartney's embassy to China, near the end of the last century; when two splendid musical snuff boxes were taken as presents to the Emperor; they played five tunes each, and opening the lid started one tune. It being desirable to obtain the utmost perfection, the musical part, and the tuning and fitting the bells, were entrusted to his late

uncle, Mr. Samuel Varley; and though the bells were smoothly cast, in that state they were like bells in dampers when compared with the musical sound from the truly turned and polished bells. The inside being made quite true to the outside caused the entire co-operation of the whole bell to produce the sound. In cast bells, there was not only the rough surface, but inequality of thickness, a cause of discord inimical to the sound, and lessening its duration. This, in large bells, was very difficult to avoid, and in thick castings, the two surfaces cooling first, often left a division within, a still greater cause of bad sound. To illustrate this Mr. Varley exhibited a sectional drawing of a casting in brass for an air pump plate, ten inches diameter; finding it unsound (by the trial of ringing), he forced air in so violently as to separate the two surfaces three-eighths of an inch, and on cutting a piece out, found the division was eight inches diameter; this defect occured so often in ordinary castings that he suspected bells could not always be free from it. A very peculiar effect was produced by the bell of Cripplegate Church, when striking the hour of twelve; the first two or three strokes being distinct and clear, but the discord becoming accumulated with every stroke, at the eleventh and twelfth a complete double sound was produced. The difficulty of ensuring sound metal in bell casting was very great, as it was generally sound on the outside only, but crystalline within. In his own experience, he had found that metal cast in a hot mould cooled with a crystalline interior. Lord Rosse, by casting on a cold face, had succeeded in getting a sound mass all through. This question, however, concerned the bell founder rather than the architect.

Mr. C. Barry, begged to inquire of Mr. Warner, who was present, whether there was any mechanical difficulty in the way of counteracting, by some kind of equipoise, the effect of moving violently so large a mass of material as a church bell. This method was applied to some of the heavy machinery in the Cornish engines with success. Of course, the effect upon the masonry of a bell tower by the mere vibration of sound, was a different thing, and the amount of dislocation so produced was inevitable.

Mr. Warner said, there was no mechanical difficulty in the adoption of a mode of equipoise, which was indeed frequently done with small bells; but it would interfere with the ringing of changes. [Mr. Barry inquired how?—Mr. Warner could hardly explain]. Small bells were rung without a wheel, the rope being fastened to a lever projecting from the stock.

Mr. Fowler, Fellow, asked Mr. Smith whether he had noticed, in towers which had sustained injury, the manner in which the framework of the bells was supported. This was a serious consideration for architects, and a point on which he had heard various opinions expressed.

Mr. Smith, referred to Mr. Ferrey's letter on that point, and to the mischief caused by ignorant churchwardens and others, who, in many cases, had got rid of the shaking of the wooden framework of the bells by driving wedges between the wood work and the masonry, to the consequent injury of the towers.

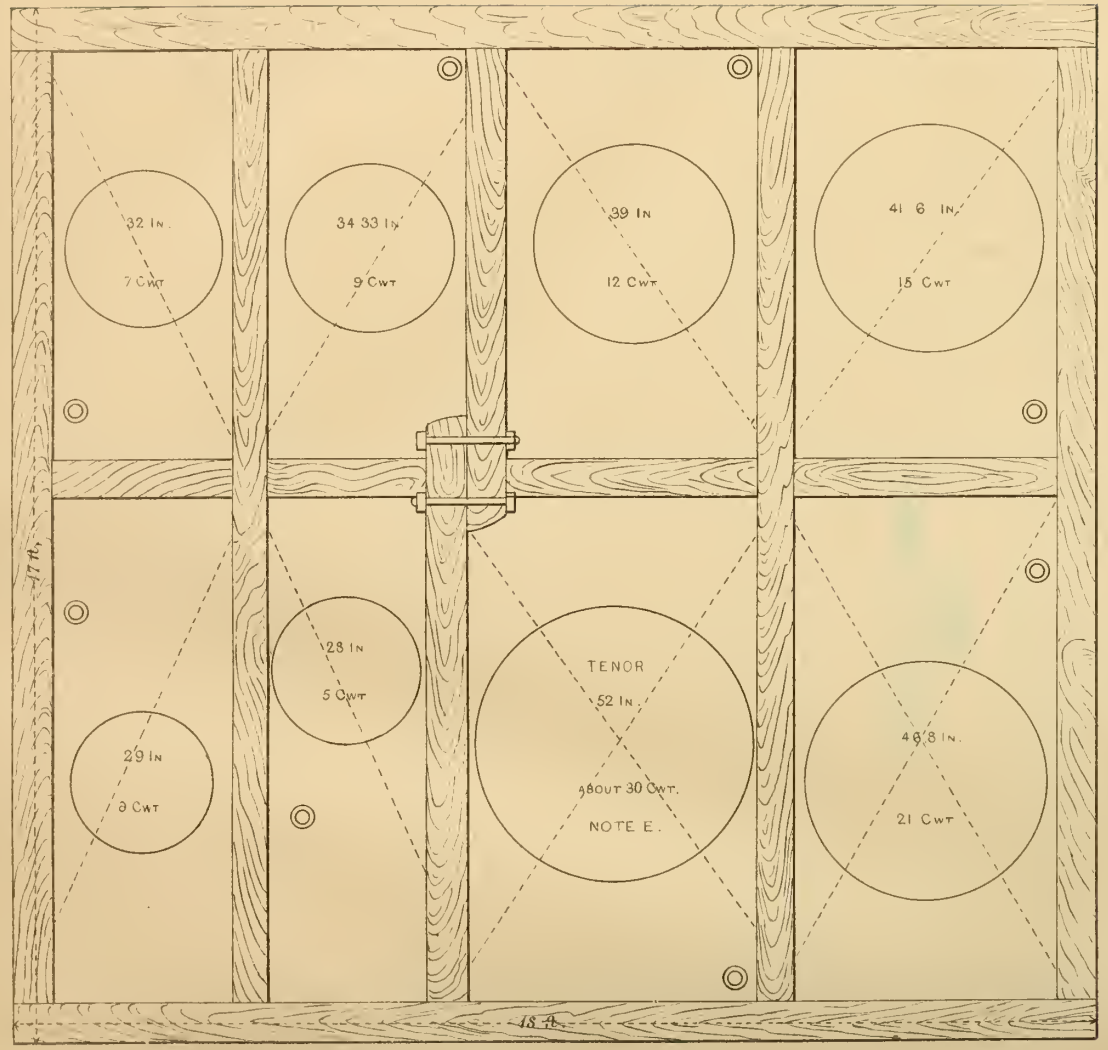
The Rev. W. Taylor, Visitor, referred to his statement last year, that the great bell at York had never been rung up to set. That statement had been contradicted by Messrs. Mears, who wrote, that it had been completely raised and fairly *rung* by sixteen men. He (Mr. Taylor), had however, sent to York for an official report on the subject, and the report was, that the bell had never been rung up to set. He was himself at York in October last, and found that, in fact, although thirty-six men had tried it, the bell had never been set; indeed with the present hanging it never would be. At York, there was ample strength in the tower for any bell to swing, whatever might be its weight. At Erfurt, the tower was very thin, but there the bell, which weighed 275 centner,* was rung up to *set* by twenty-eight men. That

* Each centner = about 110 lbs.

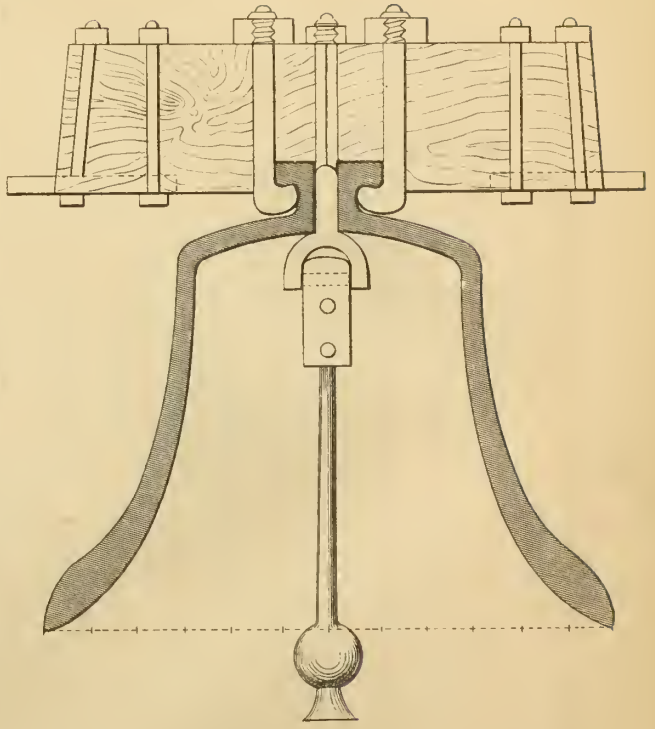
bell was not cut into the stock as at York; the latter method took from the centrifugal force, and made it impossible to get up the bell. The bell at Erfurt was 5 ells in height, and 15 ells in circumference, the ell being $2\frac{2}{10}$ feet English, and it was cast in 1497. The different sounds of different metals was an interesting question, and on that point he would remind the meeting, that at St. Nicholas, Hamburgh, very large tuning forks of cast-iron were struck instead of bells. Mr. Smith had shewn that a common mason's chisel would produce a pleasing tone, and that the note of two such chisels was the same, although one was only half the weight of the other. How then was a deep tone (such as that of St. Paul's bell) to be produced, if increasing the quantity of metal would not effect it? The note of the Erfurt bell was F, but he believed Mr. Denison expected to pitch the Westminster Palace bell in E. The continuance of the sound, and the power to be heard at a great distance, were the principal tests of a good bell; and the latter object would be promoted by hanging bells, as in Italy, on the outside of the tower, instead of enclosing them with louvre boards, &c. This point appeared to have been overlooked at the Palace of Westminster, where the outlet for the sound was exceedingly small as compared with the size of the bell.

Mr. B. Denison, Visitor, having been invited to state his views on the subject, expressed the interest he felt in it, as having been intrusted to give directions for casting the large bells for the Westminster clock. He considered himself, however, only a learner at present, and was anxious to gain all the information he could by this discussion. The subject would afford ample scope for another evening, and, whilst expressing his obligation to Mr. Smith for his remarks, he could not concur in the whole of his deductions. He should be glad to state how far he agreed with Mr. Smith, and how far and why he disagreed with him; but there would be hardly time for him to do so on the present occasion.

The further discussion was accordingly adjourned to January, 28th instant.



FRAME FOR EIGHT BELLS FOR DONCASTER CHURCH.



SECTION OF A BELL, HUNG ON Mr DENISON'S PLAN SO AS TO BE TURNED IN THE STOCK.

Vincent Brooks Lith. King St. Covent Gdn.

A DISCUSSION ON THE FORMS, METHODS OF CASTING, AND RINGING OF LARGE BELLS.

Resumed at the Ordinary General Meeting of the Royal Institute of British Architects, Jan. 28th, 1856.

The following letter was read from Mr. Chantrell, Fellow :—

"I do not see that any one has mentioned the bell at the 1851 Exhibition, which was light in weight and deep toned, the form being like that of the ordinary room clock, or pendule, a hemispheroid. The general form appears to be an equilateral triangle.* The bells of the Carillon at Bruges, said to be one of the finest in Europe, have the same form; they were cast in 1680; the greatest bell is about 10¼ tons in weight, in G, and is used to strike the hour; the half-hour bell is in C. There are four octaves, and modern pieces of music are played upon them every Wednesday, Saturday and Sunday, for the space of an hour. A large brass cylinder, 9 feet long and 7½ feet in diameter, is placed in a room below the bells, and four pieces of music are set by pegs (like the barrel of an organ) upon it, which chime every quarter of an hour. These bells are hung on wooden frames and struck by hammers outside, which are raised by wires and levers, moved by the brass barrel; they may be heard at some distance from the town. The tower is octagonal, and the eight large apertures or windows are open, so that the bells (being more than 200 feet above the ground) are seen and heard very clearly. There is a Carillon at the Church of the Dunes, attached to the Sèminaire, but being in a louvre boarded tower, it is only heard at a small distance. Some of the towers of the Churches have very small windows to the belfry, so that the bells, though large, have a very soft tone; they are tolled by having levers balanced over their heads, with stays and rails to hold by, and several boys get upon them for the amusement of balancing; the tone is very fine of some of them, those of the Cathedral especially; the St. Eloi weighed 11000 lbs., St. Sauveur 8910 lbs., one 6700 lbs., and the smallest 3500 lbs. In the Parish Church at Leeds, the belfry windows were filled in with stone tracery, part of which was taken out, because the bells could not be heard to windward; the idea was to substitute louvre boards, and while the advocates for these ornaments were straining their ears to catch the sound to windward, numbers were flocking to the town, having heard them on the first day of their being rung from the villages six or seven miles off. The bells of the chimes of Bruges have been exposed nearly two centuries, and those of Antwerp nearly the same time; they have a greater number of bells in this fine town, but they are not so distinctly heard as those of Bruges, though they are at about the same elevation. At Courtrai the Carillon is very fine, and the tunes are very distinct. All these belfries are open, and the bells are fixed; the church towers are more closed by louvre boarding and the bells swung, which appear to give a fullness to the sound, though not so loud. They are generally considerably larger than the English towers and have less oscillation. There are very many towers of our churches in an unsafe state, where I have pointed out the danger of continuing to ring the bells in our English fashion. Though change ringing may be very beautiful, I think most persons will, with me, prefer the chimes if they only once hear them on the Continent. I would observe, that the bases or mouths of the bells are all above the openings, or rather the cills, so that from below they can be seen entirely. I have had bells raised up with good effect in towers where they had been improperly placed below the cills. I find large stone corbels to support the floors in all good old towers both in England and abroad."

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* The base being the extreme width across the mouth, and the apex the highest point of the crown.

Mr. E. B. Denison, Q.C., Visitor, spoke to the following effect:—Mr. Smith said the other night that his object was to open the door to a discussion on this subject of bells, rather than to express any particular views of his own. It would have suited me better if the discussion had been postponed, until I had some more definite results to communicate to you from the experiments which we are now making with reference to the bells for the great Westminster clock. But as the discussion has been raised and specially adjourned to this evening for the purpose of your hearing from me such information as I have to communicate, I will proceed to do so without further preface and as rapidly as I can, inasmuch as the title of Mr. Smith's paper really embraces a great number of distinct questions. We have to consider the shape of bells and their composition, the mode of casting, the effects of ringing in full swing compared with striking them while fixed, and its effects upon the tower, the mode of hanging, the construction of the bell frame, and of the bell-chamber to hold it, and finally the destruction of bells by the common fate of cracking, and the methods which have been suggested for preventing it. The leading topic of Mr. Smith's lecture was the suggestion of some other form for a bell instead of the heavy and expensive article in common use. Now in this, as in most other things, it would save people a great deal of trouble if they would form a clear idea of what they want before they set to work to make inventions for effecting it. If you want a musical sound produced by percussion, several instruments were exhibited the other night, and I shall show you some more to-night, which will undoubtedly give a grander effect under certain circumstances than a bell of the same weight and of the same form. Here is the common contrivance, for instance, of a clock striking on a long steel wire coiled up, so as to produce a tone deeper than the heaviest cathedral bell, but not too loud for a room. And on the other hand, if you want a loud noise without much music in it, you can go and listen to the rivetting of boiler plates, or the shriek of a steam whistle. What a church bell or a public clock bell has to do, is to make a loud and distinct noise, with a definite beginning and immediately running off into a musical sound. Now listen to this gong, as I rouse it up to its proper roar: it makes what you think a very loud noise and also one of a musical character, and people say, look how light a gong is in comparison to a bell of the same note, and then they denounce the prejudices of mankind for not having long ago adopted or invented something in the gong form as a substitute for bells. But you probably do not know, that the gong, which sounds so loud in this room, besides not answering at once to the blow, as a bell must, especially a clock bell, is perfectly inaudible at half the distance at which a common dinner bell of no greater weight may be heard distinctly. The same is the case in a still greater degree with those deep sounding clock springs like the one I struck just now: compared with these, the common hemispherical clock bell is a powerful instrument, and gives a loud and pleasing sound at a distance where the springs are almost inaudible, and unpleasant so far as they are audible. Then there is another apparatus which was alluded to the other night as having had its capacity for sound overlooked in consequence of the old fashioned prejudice for bells; that is a circular plate, or a flat rod of metal suspended on two strings near its ends. Well, here it is, and I dare say you think the sound is very solemn and imposing compared with a bell of the same weight. But this, with many other experiments not worth exhibiting to-night, was tried by the late and the present Mr. Dent with a view to church clocks long ago; and you must be content with my telling you, as you have no means of judging of it in this room, that if you were to move off to the distance of about two rooms, you would hear this fine sounding plate as nothing better than an iron pot, while the bell would still sound clear and distinct, and more pleasing than it does here.

Mr. Taylor mentioned some gigantic tuning forks which were put up at St. Nicholas' Church at Hamburgh as a substitute for bells. I think they cannot be very successful, because Mr. Scott, who (as you all know) is building the church there, and of course knows the place well, is ignorant even

of their existence; and Professor Wheatstone, who recommended them, cannot tell me anything of their success. If they had been recognised as an effective substituto for bells, Mr. Scott and Mr. Wheatstone would have been pretty sure to hear of it. And I am sure, from the nature of the thing, it will not do for that purpose, and approaches much too near to those musical clock springs which you heard just now, and which produce such a feeble sound at a distance, when the common small clock bell is heard very distinctly. But these hemispherical bells themselves, which are of the same thickness throughout, bear something of the same relation to the common church bell with a lip or *sound-bow* much thicker than its *waist*, that the musical springs bear to the spherical bell: that is to say, they give a much deeper note from the same weight of metal, but at the same time a much weaker one. Many of you will remember two bells of that shape, or near it, in the Hyde Park Exhibition; one of them was made of Mr. Morries Stirling's "union metal," and Mr. Dent's large clock was first put to strike upon it by Mr. Stirling's desire. The sound seemed very deep and grand when struck with a heavy piece of wood, and we concluded it would be very effective when struck with an equally heavy clock hammer. But we soon found that it was impotent at a distance, much less even than the length of the building; and so that bell was replaced with one of the common form, which afterwards accompanied the clock to its destination at the King's Cross Station. The other hemispherical bell there was still heavier, in fact, very nearly as heavy as that same second clock bell, or about 29 cwt. and made of the common bell metal. It had a very fine sound when you stood near it, deeper a great deal than the note of the 14-ton bell we are going to have at Westminster. But that also was of no use at all as an instrument for making a loud noise to be heard a long way off. This is an answer to the remarks in Mr. Chantrell's letter respecting these bells in the Exhibition.

It is noticed in some books, that if you strike one of these common spherical clock bells, and apply to it a tube of half the diameter of the bell, and a length equal to the diameter of the bell, with its mouth directed towards the edge of the bell, you will rouse up a great addition to the sound. Mr. Dent and I have tried that experiment with bells and tubes of various sizes, and we find, and you shall see, that the sound of the bell is enormously increased by the tubes; and that several tubes of different sizes will do for the same bell, producing different qualities of tone. [Mr. Denison showed the experiment, and the effect was very obvious.] Well then, you are inclined to say at once, here is a means of getting a vast body of sound out of a comparatively light bell with the addition of nothing more than a tin tube. But though the musical or after sound is thus increased, the noise of the actual blow is not materially increased by the tube—certainly not to anything like the loudness of this other bell [showing one] of the same weight and the common form. And here is another curious fact: we cannot find any tube which will produce any sensible effect towards increasing the sound of this common bell, although we had no difficulty in finding several different sizes of tubes which will suit the thin hemispherical bell. If I am to offer a guess at the reason of this, it is that the upper part of the common bell, which is nearly a tube in shape, does really act as the sounding tube to the vibrations of the bell when struck. I do not propound this explanation as much more than a guess; but it is rather confirmed by the fact that applying a second tube to a spherical bell after you have got one to suit, does not do much more than using only the single one, and the shape of this upper part of a bell undoubtedly affects the quality of its sound.

Then we come to Mr. Smith's double conical spindles. It is no doubt interesting to find that a musical sound can be got out of such apparently unpromising shapes of metal by striking them in a particular way. But just take one of these spindles into your hand, and feel the weight of it compared with this small dinner bell, and now listen to the sound of the two. I think even Mr. Smith

will be satisfied that the world is not to be condemned for prejudice because we do not discard our bells, and content ourselves with hanging up the clappers alone and striking *them*. Here is one more experiment for saving a great part of the weight of a bell. My colleague in the matter of the Westminster bells, Mr. Taylor, has brought here a small bell with the greatest part of the waist cut away as you see; so that the bell now consists of little more than a widish ring hung by some strips of metal to the crown. The note is thereby made deeper, for an obvious reason which I shall notice hereafter; but I am perfectly satisfied that the bell is spoilt, though unfortunately I cannot satisfy you of it just now, because we have not a fellow to it here uncut.

Now from these and other experiments I have come to the conclusion that bells of the common and well-known shape, with a thick lip or sound-bow, are the most effective known instruments for producing a loud and musical sound, such as you want when you erect a large public clock, or put up a peal of church bells. And I confess also that after trying at Messrs. Warners' a number of experiments with bells of the usual *general* form, but with various deviations in the details, I am equally satisfied that there is nothing to be gained by deviating materially from the established proportions of the best old bells. And I think it is some confirmation of my views to tell you that Professor Wheatstone having been commissioned by the Board of Works, with Sir C. Barry, on his own suggestion, to collect information at the late Paris Exhibition "respecting the most esteemed chimes in France and Belgium, and whether there are in those countries makers acquainted with the traditions of the art, or who have applied the discoveries of science to the improvement of bells, *or to efficient substitutes for them*," has come back with the conclusion that no such efficient substitutes have been discovered, nor is there any known improvement on the established mode and materials for casting them. Sir C. Barry and he indeed seem to have been rather impressed with the merits of the cast steel bells which you may have seen noticed in the newspapers. I have not heard them myself, but I have heard such decided condemnation of their harshness of sound from other persons of probably more experience in such matters, that I do not the least believe in their being received generally as an efficient (though they may be a cheap) substitute for the more expensive compound of copper and tin: and, on the whole, that seems to be Professor Wheatstone's opinion also.

But although I have thus satisfied myself that the common form and material of large church and clock bells, such as we want at Westminster, are substantially the right ones, there still remains a great deal to do to ascertain the more precise details of form and composition which will produce the best sound out of a given quantity of metal. And here I considered that we had to begin at the beginning, and it is hardly an exaggeration to say, that instead of presuming that anything is right because we now find it in use among the bell-founders, it is rather safer to presume that it is wrong. That there is something very far wrong somewhere in the modern style of casting bells, and especially large bells, is manifest from this—that everybody who has paid any attention to the subject, complains of the lamentable inferiority of modern bells to old ones, and even to bells made in the early part of this century. Let me quote again that same letter of Prof. Wheatstone's to the Board of Works, with reference to this subject:—"The very unsatisfactory result of the chimes constructed for the Royal Exchange, which have been twice re-cast, without any ultimate advantage, shews that no known bell-founder in England can be relied on." And then he makes the suggestion which I quoted just now. I know perfectly well that the makers of all these three unsuccessful peals of large bells (two of which were cast by Mr. Mears, and the third by Messrs. Taylor, of Loughborough), can produce volumes of testimonials to the excellence of their bells. But I have seen rather too much of testimonials to pay much regard to them, whether they relate to bells, clocks, or morals. To say nothing for the present about the two latter articles, I have heard people describe bells as "very fine," which

I would not buy at a penny a pound, except for the purpose of selling again at ninepence. As for the opinion of musicians, as such, I value it rather less than that of other people, because I have always found that the first and almost the only thing they look at, is whether a peal of bells are in tune with each other, the least important part of the business for two reasons; first, because if they are out of tune (unless very atrociously), they can be cut into tune; and secondly, because a set of iron saucepans could be made as perfectly in tune as the finest peal of bells. And with regard to single bells, where the question of tune does not arise, still, unless a man knows by experience what kind of sound a certain weight of bell metal ought to produce, it is impossible that his judgment can be worth anything on the merits of any particular bell. Most Oxford men believe their Great Tom is a very fine bell, just because it makes a loudish noise, and they have no idea, and cannot have any, whether it is either the quantity or quality of noise which ought to come out of a bell of $7\frac{1}{2}$ tons. Whereas, I know that a *good* bell of half that weight would give a much louder and a much pleasanter sound, and that in fact, the bell is about as bad as possible. I mention that because it is not a modern one, having been cast in 1680; and because the *occasional* occurrence of bad old bells, and also of good modern ones, proves that the general badness of the modern ones, compared with the general goodness of the old ones, is not to be accounted for by the hypothesis that they improve by age; though it is true, that they generally do improve a little for a few years. Without saying that any of the modern large bells, such as those of York, Lincoln, and Montreal, are quite as bad as the Oxford bell, they are all very far short of what they ought to be, and very inferior to the *old* Tom of Lincoln, which was cast in 1610, and was considered the finest large bell in England, as I can easily believe from the density of the metal, of which I have a piece, and I shall say more about it presently.

It has been stated in substance by the founders of the two first condemned Exchange peals, that the second of them at any rate must have been good ones, because they (or most of them) were cast from the same *sweeps* or patterns as the celebrated Bow bells, which were cast by the predecessors of the same firm in the last century; and indeed they say the same of many others of the modern peals which people are stupid enough to pronounce very bad. I am rather inclined to think, that this identity of shape, together with the inferiority of sound which is manifest to everybody except the founders, proves something very different, viz., that they have forgotten the traditions of their own art and of their own house; and as the quality of bells cannot possibly depend on more than these three things—shape, metal, and casting, and they themselves tell us that the shape is the same, they leave us no other solution, except that they use bad metal, or have lost the art of casting it properly, or both. That some of the modern bells are unsoundly cast, I can say positively, because I have seen the metal full of holes, which are sometimes visible on the surface, but sometimes, and I suspect more frequently, invisible until the bell is broken. The larger a bell is, the more likely this is to happen, as it is well known that thick castings are harder to make sound than thin ones; and that is an obvious explanation of the fact, that the large bells of modern times are even worse than the small ones. Now it luckily happens, that we have a ready means of discovering whether a bell is both soundly cast and of good metal, by simply taking its specific gravity for the soundness, and analysing a piece of it for the purity. You may file off enough from any bell to enable a chemist to analyse it, and see whether it contains any baser (*i. e.* cheaper) metals than copper and tin. And we know what the specific gravity ought to be: the old Lincoln bell was 8·78, and the old Doncaster bells (of 1722, not 1835, for some of the latter I know were unsound) were 8·76: the French authorities on the subject, I find, put it as high as 8·82, and from actual experiment. It is remarkable, that there is scarcely any difference between the specific gravity of the alloy, whether it contains the largest or the smallest proportions of tin to copper that are ever used; because, though the tin is

much lighter, it makes a denser compound with the copper until it reaches the proportion of speculum metal, about 1 to 2; whereas, bell metal never has more tin than 1 to 3, and the modern bell metal not so much as 1 to 4, because it is only put in in those proportions, and some of the tin always wastes in melting. The rule for getting the specific gravity is so simple that I may as well give it. Suppose the weight of the bell is A, then weigh it in water (taking care that it is both filled and submerged), and call that weight W; then the specific gravity $= \frac{A}{A-W}$; which ought to be 8·75 at least. With regard to the best proportions of tin and copper I am not able yet to state any certain conclusions. The fact, however is, that the old Lincoln bell contained rather less than ·75 of copper, and the rest was tin ·20, and antimony, and a very small quantity (no doubt accidental) of nickel, with what the chemists call mere traces of some other metals. There was, some years ago, a fashion of putting antimony into speculum metal, but it seems now to be thought better to fill its place with tin. No antimony is found in the old Doncaster bell metal, nor I understand, in that of the old York bells, in which the proportion is 1 of tin to 3 of copper, as in the Lincoln bell it is about 1 of tin and antimony together to 3 of copper. I find also in a French book on alloys, three authorities for 1 of tin to $3\frac{1}{2}$ of copper, others for 1 to 3, but only one for 1 to 4. I will just caution you against confounding 1 *to* 4 with 1 *in* 4. Remember, that if the tin comes out on analysis one-fourth of the whole, or ·25, it means that the tin is not one-fourth, but one-third of the copper. I mention this, because I have constantly found people confound the two things in other matters besides bell founding. The bell founders do not like this *high* metal, as it is called, because it is harder to cut if the bells require tuning; but they have no business to want tuning, and never do when they are cast of the proper thickness for their size. If the high metal is the best, that is a singularly bad reason for not using it. So far as I have yet been able to judge from experiments, I am of opinion that it is the best, for the more the tin is reduced below the point where it would make the metal too brittle, the less time the bell appears to hold the sound when it is struck. Lord Rosse adopted a multiple of what are called the atomic or equivalent proportions of tin and copper in his great speculum, which are 59 and 32 very nearly; and from some facts which Mr. Dent has told me about different compositions for chronometer springs, and other experiments, there seems reason to believe that there is some advantage in keeping to the chemical equivalents. At any rate it can do no harm, and you will find that 4 of tin to 13 of copper, does give very nearly the ratio of 59 to 6×32, and it certainly produces a very hard, and elastic, and strong bell metal, very like the Lincoln bell in appearance.

I have not time to enter into the details of casting, nor is there any occasion for it. I have told you how you may ascertain whether any given bell is made of sound bell metal; and if the bell-founders are made to understand generally, as Messrs. Warner do with regard to the Westminster bells, that their bells will be rejected if they are not made of sound bell metal of proper density, they will take very good care that they are. I will however just mention that Lord Rosse's method of getting a sound speculum, by casting it on a cold bottom, would not do for bell-founding; for you will see at once, that a thing of the shape of a bell cannot cool in layers like a flat speculum of uniform thickness. What we want, is a method of keeping the metal in the upper part or waist of the bell hot and fluid as long as possible, so that it may keep falling down into the sound bow or thick part as the metal cools there. Moreover, copper and its alloys of tin have this remarkable property, that the slower they are cooled, the harder and denser they are. A bell metal bullet cast in a cold mould and thrown into water as soon as it is solid, is quite soft and stringy inside, though very smooth outside, compared with one cast in a hot mould and cooled as slowly as possible; indeed they are so different, that you would suppose the latter had twice as much tin in it as the former if you did not know their history. Mr. Varley tells me, that some copper cylinders for printing were

cast of even greater density than hammered copper, by forcing the metal down into the runner or "git" with a piston heavily weighted. Messrs. Warner's plan of casting bells from iron cores and copes, coated only with the loam, seems to offer great facilites for this forcible mode of densification.

But there is another cause of the inferiority of modern peals of bells, which is still more easy to judge of and to get rid of, if you choose. It was noticed in a short paper on bells in the Ecclesiologist, vol. XIV, that less metal is now used to produce a given note than in the old bells. Of course, if the result was equally good, that would be a great proof of the skill of the modern bell-founders. But unfortunately, the result is very bad. I do not think, however, that they are so much to blame for it as the public, who in this, as in everything else connected with building, are always demanding grand effects out of insufficient means. At the same time, as the bell-founders seem rather disposed to humour than to correct the public ignorance on this point, I will try at any rate to make you understand this fallacy. First of all then remember, that any musical note can be got out of any weight of metal. You may get a note an octave or two deeper than the E flat, which I expect our great Westminster bell to be, out of 14 ounces just as well as 14 tons of bell metal, if you only make it thin enough. And on the other hand, we could have that 14 tons of metal cast into a bell with a note one or two octaves higher, if we only made it small and thick enough. In the former case you know, we should have a bell that would be scarcely heard at the distance of ten yards instead of ten miles; and in the latter, the mass would be too thick to be put into musical vibration at all, and it would give very litte more than the mere sharp noise of a blow. Somewhere between these limits necessarily lies the thickness and shape of a bell which will give the best sound for its weight; if you make the bell larger and thinner than that best form (whatever it is), you lose in power and quality of tone, though you increase the depth of note; and if you make it smaller and thicker you raise the note, and when you get beyond a narrow limit you lose in power too, because the bell becomes too thick to be made to vibrate throughout. Now, I am quite satisfied, and I believe it is generally acknowledged, that the most effective proportions for a bell are where the thickness of the waist is about $\frac{1}{36}$th, and that of the sound bow about $\frac{1}{12}$th of the diameter. And these proportions will, of course, give one definite and ascertained note, and no other, for any bell of given weight and shape. The tenor at Bow for instance, is C, and weighs 53 cwt. But Messrs. Taylor have made the tenor of their new peal at the Exchange, of the same note, with only 33 cwt; and in some other peals which I have seen, they have deviated still further from the old proportions, for they carry this system even further than the other bell founders. Again, it is a law of mathematical certainty, that if you make eight bells of any metal and any shape, provided only they are all of the same metal and proportions (*i. e.* the thickness varied in proportion to the diameter), and of dimensions in this ratio—30, 32, 36, 40, 45, 48, 60, they will give the notes of the common diatonic scale, and in fact, be a peal of bells in perfect tune with each other. Moreover, their weights will vary as the cubes of the diameters, or the tenor be eight times as heavy as the treble. But in practice it is found expedient to make the two or three smallest bells, especially the treble, rather thicker and heavier in proportion, and within moderate limits there is no objection to it. For instance, in the grand old peal of Exeter Cathedral, the tenor is 67 cwt., and the third of the ten is rather more than one-seventh instead of one-eighth of that weight. But in modern peals, you will be lucky if you get a tenor of eight bells more than four times as heavy as the treble, or the tenor of six more than double of the treble, though it ought to be nearly four times as much, even allowing for a little increase of thickness of the treble. Now, when you have not only inferior casting, but this system of spoiling all the large bells of a peal by thinning them besides, you need not be surprised at the universal complaints of the badness of modern bells. The remedy for this is simple enough: stipulate that no bell in the peal is to be thinner in the sound-bow

than $\frac{1}{13}$th of the diameter, and this defect will disappear at once; only in that case people must give up making the absurd demand upon the bell-founders to give them a peal of bells in E for the money which will only buy copper and tin enough for a peal in G. When the specification was issued for the Westminster bells, one of the bell-founders wrote to ask what note Mr. Denison intended the great bell to be: I answered that Mr. Denison intended the bell to be of such note as it might turn out to be when made of the proper size and thickness to produce a good bell of 14 tons. *I expect* that note will be E flat, but I cannot say positively that it will be lower than E, because I have not yet quite determined the exact proportions which seem to be the best, by casting experimental bells of a quarter of the size, or $\frac{1}{64}$th of the weight, and consequently just two octaves higher. The third quarter bell will be the octave above the great bell, and therefore half the size and one-eighth of the weight. You will find the order and construction of the chimes, and of the clock itself in the Treatise on Clocks, which I wrote for the last edition of the Encyclopædia Britannica, and which was separately published by Black, of Edinburgh, last year.

This is a convenient place for giving a list of the largest bells in the world, according to the best information I can get from various sources:—

	Weight. Tons.	Cwt.	Diameter. Feet.	Inches.	Thickness. Inches.	Note.
The great bell of Moscow, broken in 1737	193		21		23	
Bell at the Kremlin, fell in 1855	63		...		...	
Pekin	53		...		...	
Novogorod	31		...		...	
Vienna, 1711	17	14	9	10		
Sens	15	0	8	7		
Westminster, 1856	14		9	2	9	E flat
Erfurt, 1497	13	15	8	$7\frac{1}{2}$	...	F
Notre Dame, Paris, Louis XIV.	12	16	8	7	$7\frac{1}{2}$	F probably
Montreal, 1847	12	15	8	7	$8\frac{1}{4}$	F
Cologne	11	3	...		...	
York, 1845	10	15	8	4	8	F sharp
Bruges	10	5	...		...	G
St. Peter's, Rome	8		...		...	
Oxford, 1680	7	12	7	1	$6\frac{1}{8}$	
Antwerp	7	3	...		...	
Exeter, 1675, very thick in the waist	5	11	6	4	5	A ?
Lincoln, 1834	5	8	6	$10\frac{1}{2}$	6	A
St. Paul's, 1709	5	4	6	$9\frac{1}{2}$	...	
Ghent	4	18	...		...	
Boulogne, modern	4	18	...		...	
Old Lincoln, 1610	4	8	6	$3\frac{1}{2}$	...	B
Fourth quarter bell Westminster, 1856	4	0	6	$1\frac{1}{3}$	6	B flat

You observe that the diameter of the Erfurt bell, which is said to be the finest in the world, is less than Mr. Taylor's figures. As both his authority and mine agree about the weight, and this size is given me by a very accurate person who measured it himself, and it is more consistent with the weight than the much larger size printed last week (the bell being a very thick one), I have little doubt that this is correct. Others give also several greater sizes and weights for the Notre Dame bell, but these are the figures lately obtained by Mr. Donaldson from M. Viollet le Duc, the architect superintending the works at Notre Dame now, and he has sent a drawing of the actual figure, or sweep of the bell on a large scale; so that this also seems to me the most likely to be correct. I must add that the clapper is stated to be of the enormous weight of 23 cwt., or $\frac{1}{11}$th of the weight of the bell, which is about four times as much as I have ever seen suggested for the clapper of a ringing bell, though I lately had one put to a tolling bell of twice the usual weight, with very good effect. But M. Viollet le Duc has fortunately sent the dimensions of the clapper also; and it is clear from them, that the weight

which has been given to him is fabulous, and at least three times too much. Even 7 cwt. would make it twice the weight of the clappers of the York and Montreal bells. I suspect ours are generally too small, and I am certain that when the bells can only be tolled by reason of the weakness of the tower, much larger clappers might be well and safely used, provided the bells are really tolled, and not the clappers pulled against them with a force which depends entirely on the discretion of the man who does it. When the bell is too heavy to be tolled in the common way, the clapper ought to have a separate pulley, not at the side, but in front of the middle of the bell, and so placed that the ringer cannot hold the clapper against the bell. I believe more bells have been cracked by the slovenly practice of tolling by the rope tied to the clapper, than by all other things together, besides its twisting the clapper itself on one side, and deranging it for ringing. This is only one of the many points in which the saving of shillings often entails the waste of pounds, and sometimes hundreds of pounds, as at Doncaster in 1835, where the whole peal was recast at a cost of £300, because the two largest bells had been cracked through mismanagement.

It did not appear to me that Mr. Smith made out a very good case against the swinging of bells. Indeed, as Mr. Barry said the other night, his own experiments were enough to satisfy us at that end of the room (if we had doubted it before) that swinging a bell, or a gong either, does increase the sound considerably. The notion of ringing bells in full swing being modern and contrary to the intention of those who built our church towers, seems to me to have no shadow of evidence to support it. Peal-ringing it is true is said not to have come in till the sixteenth century; but even that is a good while ago, as we are now in the middle of the nineteenth; and all the old bell frames that I have seen, which are generally made much stronger than the modern ones, show by their form that the bells were intended to swing, at any rate, as high as the horizontal position. The mere vibration of a tower while the bells are ringing, is no proof that it is in danger; for stone, like everything else, is to a certain extent elastic. Bells of course may be too large, or hung too high in a tower to be rung safely, and then they must be stopped and only tolled, or hung lower down; but there are plenty of towers which have been vibrating every time the bells are rung for centuries, without being any the worse for it as far as we can see from any symptoms in the building. Nevertheless, as I am addressing a good many architects, I take the liberty of telling them that I lately received a letter from an old member of a London bell-ringing society, who appears to be well acquainted with all the peals in London and the neighbourhood, making the remark that there have only been two church towers built in the last 30 years which are really fit for a good sized peal of bells, viz. St. Giles's, Camberwell, and St. John's, Hackney. I can answer for it myself that the vast majority of modern towers are totally unfit for a peal of eight bells, which ought to have a square of 18 feet inside the tower at least; and even that allows nothing for a clear space all round the bell-frame, as there ought to be. When the tower is small, even if bells of the proper size for a peal of eight (of which the tenor ought never to be less than a ton) can be got in, they are too close to the walls, and those in the corners cannot get their sound out of the windows, which moreover are nine times out of ten too small. Too large they cannot be for this purpose; and they ought to be as little as possible filled up with louvres. A few broad stone louvres not much overlapped, and wire netting to keep the birds out, are better and look better than anything else; and the windows and bells ought to be so placed that the mouth of the bells is neither below the windows when tolling, nor above them when ringing. A bell of 1 cwt. in an open bell gable is sometimes heard farther than a bell of 20 cwt. in a close bell chamber. I am glad to say that Sir C. Barry has now arranged a perfectly open place, which you may see half way up the spire or roof, for the great Westminster clock bell to stand in, instead of being within the roof as originally contemplated.

If persons who have only raised £250 or £300 for bells, would spend it on a couple of large ones instead of five or six small ones, it would be a great deal better. The ringing of two large bells together

has a fine effect; and some day or other they might become the tenor and 7th of a good peal of six or eight. It is surprising to me how some of the richest parishes in London submit to the clanging of one or three bad small bells, when it would cost so little to replace them with good ones. That of St. George's, Hanover-square, sounds as if it were made of cast iron.

I must say a few words on the subject of bell hanging. I noticed last year the common and mistaken notion of the bell founders' carpenters, that by hanging bells at right angles to each other they will counteract each other in swinging. I now give a sketch of eight bells hung as they have been in Fredericton Cathedral and are intended to be in Doncaster Church, all swinging north and south (in which direction the tower is strongest), but in opposite directions, and the frame well tied together by diagonal braces at the bottom, so that it must all move or stand together. This horizontal diagonal bracing has generally been altogether neglected, and consequently you see one part of the frame moving one way, and another another, and trying to tear itself to pieces and damage all the hanging of the bells. The fallacy of hanging large bells high in the stock has been sufficiently exposed by Mr. Taylor. It has arisen from the ignorant and absurd idea that a bell is *lifted* up, like a stone by a lever, instead of being *swung* up by centrifugal force, like a stone in a sling, and kept swinging just as the pendulum of this great clock is, by nothing stronger than a musical box spring, wound up every half minute, which of course could not lift a pendulum of 6 cwt. the millionth part of an inch. And as for the high hanging making the large bells swing faster, and nearer the time of the small ones, it does just the contrary; because the lowering of the point of suspension in a large mass does not necessarily accelerate its vibration at all; and the great increase of friction from hanging the bell on the grindstone system, or as near the centre of gravity as they can get, certainly makes it slower, and more difficult to swing up, and to set when it is up, and also certain to rise false, or with the clapper on the wrong side.

To follow the subject to its end, I must not overlook the disease of which bells generally die, that is, cracking after the clapper has worn them thin in one place. I see Mr. Baker's model of his patent plan for turning a bell in the stock again upon the table. I will not repeat what I said of it last year. But as I am certain it will never be generally adopted, I beg to offer you another (without a patent) which you may remember I suggested in this room when I first saw the other, and have now had executed. You will understand the plan in a moment from this drawing. It is nothing but a thick round neck to the bell instead of a crown, with a flanch round the top, which is embraced by six bolts coming through the stock. The clapper-bolt runs square through the stock, but round through the top of the bell, and has nothing to do with carrying the weight of the bell (exactly the opposite of Mr. Baker's plan). When the bell is worn in one place, you have only to loosen the bolts a little, and then a few of the ringers standing round the bell will easily twist it round a little way for the clapper to act in a fresh place. If this is done once in 10 or 20 years, according to the work of the bell, it may just as well last 1000 years as 100, and this mode of hanging evidently need cost not a penny more than the common plan.

I must apologise for the unusual time I have been talking on this subject. I did not introduce it; but having been specially invited to give you my views upon it, and no practical information that I know of having been yet published upon it in England, I have endeavoured to say something that may be of use on all the topics included in the title of Mr. Smith's paper.

The Chairman, Mr. Penrose, V.P., observed that there would not be time to continue the discussion, and the members must decide whether it should be resumed on another evening.

Mr. Smith, Hon. Mem., expressed his extreme gratification at having been the means of eliciting so much valuable information from Mr. Denison; and an unanimous vote of thanks to Mr. Denison having been passed, an adjournment of the discussion was agreed to.

A DISCUSSION ON THE SUBJECT OF BELLS,

Resumed at the Ordinary General Meeting of the Royal Institute of British Architects, Feb. 11th, 1856.

Mr. W. L. Baker, C.E., Visitor, having requested permission, proceeded to read some remarks:—

Large bells of a shallow basin shape are now used in some cemeteries, and are found to give a deep note but weak in power; they thus possess the advantage of not being heard at a distance. But it is from the ogival bell, that the loudest, clearest, and best quality of sound may be obtained; we therefore find this shape almost universally adopted in the bells of our church and clock towers. The best modifications of this general form, the precise curves of the sweep, the various thicknesses, and the nature and treatment of the alloy to be used, must be determined by the practical experience of the bell-founder, who, no doubt, may be assisted by scientific research and careful experiment. It is therefore to be hoped that the details and results of all experiments and calculations connected with the bells for the clock tower of the Palace of Westminster will be published.

It has been proposed to cast bells without external beads or inscriptions; but I cannot think this omission of any importance, as the beads seldom project more than one-sixteenth of an inch, nor the lettering more than one thirty-second. It is much more important to get the inside of the bell perfectly concentric with the outside. The inscriptions, generally giving the date when the bells were cast, are often interesting and instructive. Much has been said and written lately about the superiority of old bells over modern ones: the results of my experience do not entirely coincide with such statements, some of which are perhaps partly due to a natural tendency to find excellence only in the productions of former times. There are many old bells belonging to peals in country places, that have a diameter of mouth equal to sixteen and a half times the thickness of the sound bow, and their sound is consequently weak and panny. The tuning of old bells was often very imperfect, probably on account of the great expence attending the process, which was done entirely by hand with hammer and chisel. At the present day the tuning is effected with much greater accuracy and much less expence by a revolving cutter driven by steam power; but still there is no doubt that modern bells are in many instances anything but what they ought to be; and I have lately discovered in examining a new peal of bells, what appear to me very startling anomalies both in their shape and thickness. We have also heard high praise of Foreign bells. I have heard bells in France, Portugal and Brazil, and my impression is, that on an average French and Brazilian are inferior to the bells of this country. There are, however, some excellent bells in the Cathedral at Lisbon. I saw last summer the great bell the "Bourdon" of N. Dame, at Paris; the diameter of its mouth is eight feet six inches and three-quarters, and the thickness of sound-bow is eight inches; it weighs about fourteen tons, and the indentations made by the clapper are $1\frac{1}{8}$ inch deep.

The effect of ringing is very different from that of merely striking bells while stationary, or, as it is technically called, chiming them. In ringing, a bell is made to perform a series of oscillations, and is struck once at each oscillation; it thus throws off the sound in a great number of directions owing to the arc it describes, and may be said to cause the air to vibrate in a series of rings expanding in an infinite variety of non-parallel planes, which intersect one another, and cause that pleasing undulatory vibration in the air so peculiar to ringing, and which cannot be obtained by chiming, or in any other manner.

A suggestion has been made during this discussion by Mr. Varley, to hang bells above the ridges of tower roofs. Bells may be seen hung in this way in France, and under suitable circumstances, the

same plan might be adopted in this country. The bells of the churches at Rio de Janeiro are all hung in the tower windows, and some of them are of considerable size, one bell always taking up the entire width of a window. I have never observed more than four bells in the same tower. They are hung upon immense ornamental wooden stocks, the gudgeons of which run in bearings let into the granite sides of the windows, so that no frame is required. The stocks have one, and in the case of heavy bells, two levers attached to them, projecting inwards at an angle of about 30 or 40° above the horizontal line; short ropes are attached to the levers, and the blacks who are employed to ring the bells stand on a floor in the tower, placed on a level with the bottom of the bell windows, and with the simple tackle I have described, manage to raise very heavy bells and to set them without stays and catches. Bells thus hung in tower windows are very picturesque objects, and probably there would be no objection to a few irregular sized bells being thus placed. But it is quite out of the question to think of hanging peals of bells in this way, because the different positions of the bells in reference to the surrounding neighbourhood, causing some to quite overpower others, would seriously interfere with the beauties of change ringing, and there would be many objections to hanging them all in windows on one side of a tower.

Some towers, from their positions and proportions, are no doubt better calculated to do justice to bells than others. The clock tower of the Palace of Westminster stands boldly out from the surrounding buildings and rises to a considerable height above them. I have heard with astonishing distinctness, in the neighbourhood, the noise of the hammers and chisels of the workmen engaged in the erection of its iron roof. The fine position determined upon for the large hour bell resembles that suggested by Mr. Varley of a bell hung above a conical roof with a sounding board over it.

Mr. Smith has particularly alluded in his paper to the injury occasioned to towers by the lateral strains to which they are subjected by the ringing of the bells, and Mr. Ferrey has stated that he has had "frequently to deplore the serious injuries caused to the towers by the action of the bells." My own experience is more limited, but I have been in many ringing rooms and bell chambers during the ringing of peals, and have often placed my back against the wall so as to become more completely sensible of the nature of the oscillations of the tower. These have invariably appeared to be of an elastic character, and it is evident that in a well built tower, oscillations not exceeding the limit of elasticity of the material of which it is constructed cannot injure it or interfere with its stability. The floor of the ringing room of St. Martin's in the Fields is about on a level with the top of the balustrade over the cornice of the Church, and even at that level the tower oscillates very considerably during the ringing of a peal, but good workmanship and the elasticity of the materials have prevented its peal of twelve, weighing about 147 cwt., doing it any injury; in fact, the tower is as sound now as ever. Another feature peculiar to the movement of a tower during the ringing of a peal is, that the consecutive arrangement of the bells in certain changes will cause it to oscillate very considerably, while during the ringing of other changes no oscillation will be perceived. Church towers are much better built now than they were twenty or thirty years ago both in regard to their size and stability, but the internal arrangements of the bell chamber and ringing room are often, in many respects, inconvenient. In some, built within the last ten years, the ringing rooms are the chambers immediately under the bell lofts. They are consequently so noisy and confusing to the ringers that it is next to impossible to ring complete peals in them. A double ceiling would in some measure remedy the evil, but an intermediate chamber between the bell loft and the ringing room would be still better.

Bell frames should be made as perfectly rigid as possible, and all tendency to twist provided against. If laid on a stout floor, they would be stiffened by being well secured to it, especially if the flooring boards were laid diagonally. The floor should be well spiked to the girders. The plan, described by Mr. Ashpitel last year, of laying the frames, floor, and girders without

fixing them to one another, would not reduce the thrust on the tower, and would allow them to work about in a very objectionable manner, causing great additional labour in ringing the bells. The more rigid the frame, the easier the bells travel. Iron frames, therefore, properly constructed, are better than wooden ones, with the advantage also of greater durability. My model on the table shows a cast iron frame for a single bell of large size; a horizontal diagonal brace introduced below the bell counteracts any tendency to twist. This brace is raised from below and bolted in its position after the bell has been hauled up into its place. Bells are more conveniently accessible when the frames are not laid on the floor, but the latter is fixed 4 ft. 6 in. or 5 ft. below the lowest parts of the framing; this arrangement gives access under the bells to the clappers, and allows the loft to be freed from rubbish, great quantities of which are sometimes brought in by birds, but should not be allowed to accumulate and rot on the floors or between the bell frames.

In France the louvre windows of bell towers are frequently of gigantic proportions, the bells being suspended in an immense wooden frame of vertical, horizontal, and diagonal timbers, built up from the bottom to the top of the windows, like an internal and independent tower. The 14 ton bell at Paris, to which I have already alluded, and three smaller bells are hung in a frame of this kind, the louvres being attached to the bell framing. Although the extreme angle described by the centre line of the 14 ton bell, when ringing, is only equal to about 90°, the frame oscillates considerably with it, north and south, and even when the oscillations of the bell become very small after it has ceased to sound, the lateral movement of the frame and louvres may be seen from the street below. Any movement in a bell frame is objectionable, and shows that it is not equal to its work. Peal ringing is unknown in Paris, and the bells (of which I believe there are not more than from one to four in each church) are universally rung by the feet of the ringers standing above the bells, by means of treadle levers bolted at right angles to the sides of the stock near its ends. With the present arrangements, eight men only can conveniently be engaged at the same time in thus ringing the 14 ton bell at Notre Dame.* The operation appeared to me awkward and attended with some danger to the ringers.

It was stated in the previous discussion that when the crown is let up into the stock, a bell will be raised with more difficulty than when it is attached to a stock which is straight on the underside; and that the greater the centrifugal force developed by the swinging of any bell, the more easily will it be raised. Now in raising a bell, a man imparts as much force as he is conveniently able to supply, and as long as the force continues to be greater than that required to overcome the resistance of the air and the friction of the gudgeons, and thereby to maintain the oscillations of the bell in any given arc, the remaining force causes the bell to describe a greater arc at each oscillation, till ultimately it is completely raised. The time of oscillation and the angular velocity of any given bell will be about the same, whether the crown is let into the stock or is attached to a straight stock; the actual velocity of the mouth will therefore be greater in the latter case, the bell will meet with more resistance from the air, and will consequently require more power to raise it; the centrifugal force will also be greater than in the former case, and the friction of the gudgeons will be increased, occasioning still further exertions on the part of the ringer. With a straight stock, the whole work to be done is greater, as the centre of gravity of the moving mass has to be raised through a greater distance, and the same amount of power being applied, more time will be required to raise it. The

* Mr. Papworth, Fellow, has communicated the following particulars of bells in Germany:—Olmutz, 358 centners (about 17 tons 18 cwt.); Erfurt, Maria Gloriosa, 1497, 275 centr. (about 13 tons 15 cwt.); Cologne, 1448, 224 centr. (about 11 tons 4 cwt.); Breslau, 1507, St. Elizabeth's Church, 220 centr. (about 11 tons); Gorlitz, SS. Peter and Paul Church, 217 centr. (about 10 tons 17 cwt.); Halberstadt, the Dominica, 1457, 150 centr. (7 tons 10 cwt.); Dantzic, St. Maria Church, 1453, 121½ centr. (about 6 tons 1½ cwt.)

following advantages, then, are obtained by letting the crown of a large bell into the stock,—it is raised with not only less effort on the part of the ringer, but also in less time; there is less strain on the stock and the bolt or bolts connecting the bell with the stock; there is a less lateral thrust on the tower, and lastly, the framing in which it hangs not only requires less strength, but may be made more compact, and consequently less expensive. With respect to the clapper going up on the wrong side when the bell is raised, I do not conceive that that practically influences the raising of the bell one way or the other. There is scarcely a tenor bell in London, the clapper of which does not go up on the wrong side, the only practical disadvantage being, that a man has to go up and turn it on the right side, after which the bell will clapper just as well as if it had been raised with the clapper on the right side.

The following facts will clearly show the advantage of letting the crown of the bell into the stock:

The bells of Bow Church, Cheapside, after twelve years' silence were re-hung in the year 1835, and the crown of the tenor bell was let up further into the stock. Since the alteration, that bell weighing 53 cwt. has been rung by one man for four hours and five minutes in a peal of 6000 changes, whereas before the alteration it had never been rung single handed in any peal.

The 42 cwt. tenor of St. Michael's, Cornhill, could never be rung single-handed till the year 1840, when its crown was let further up into the stock, and since that alteration it has been always rung in peals by one man.

At St. Giles', Cripplegate, we find a peal of twelve bells, the tenor being 36 cwt. In the year 1843, they were re-hung, and the crowns of the larger bells were let up further into the stocks. In the year 1851, a peal was rung in this tower consisting of 7524 changes, in five hours and twenty-four minutes, during the whole of which time Mr. John Austin, then between fifty and sixty years of age, rang the tenor bell unassisted.

The ordinary wooden slider, alluded to in the discussion on bells last year, is a bar of wood lying across the bottom of the cage in a horizontal direction; it is fixed at one end, and is generally made curved in order to clear the skirt of the bell and the ball of the clapper, and at the same time to get the other end close up under the mouth of the bell within the range of the stay, the length of which is limited by the framing. The slider must therefore generally be a piece of carpentry, and not a mere stick. This kind of slider is replaced in my plan of hanging bells by a vertical iron catch, which is not only simple and strong, but occasions much less friction than a horizontal slider.

I do not participate in the fears expressed by some gentlemen that one bolt would not stand the strains of a heavy bell in a state of oscillation; whatever the strains may be, it is evidently quite possible to make the bolt strong enough to resist them, and the sufficiency of a single bolt is still more obvious in the case of bells that are to remain stationary, like those intended for the clock tower of the Palace of Westminster. Hung in this manner, such bells could be frequently and easily turned round their vertical axes, and the wear occasioned by their enormous clappers and hammers spread round their sound bows. If the 14 ton Westminster bell is hung in the manner shown on the drawing now exhibited by Mr. Denison,* it will be a much more difficult matter to turn it about its vertical axis than is perhaps at all contemplated. It is ridiculous to suppose that such a bell can be slewed simply by the hands of a few men. In order to accomplish this operation, a quantity of tackle, screw jacks, and in all probability, planks and staging will be necessary; and taking into account the time and labour requisite to hoist these to the top of a very high tower, to move the bell, and then to remove and lower the tools, tackle, &c., we shall find the operation, under the most favourable circumstances, attended with very considerable expence. It would be much better to slew a bell once every six

* See illustration given with the last Paper.

months than once in ten years as has been proposed, and a 14 ton bell might be fitted with a permanent apparatus for doing this, without interfering with or stopping the striking of the clock, for much less money than it would take to move the bell once without it.

It was mentioned by Mr. Ashpitel in the discussion last year, that "he had observed at Rome that the clapper was hung so as to have some play round the sound-bow, and not to strike always on the same point." I have observed the same thing myself in foreign bells, but it would not do for the clappers of a peal of bells to have any lateral motion, because they would not then clapper with any degree of accuracy. I have recently been very positively informed that in breaking up old bells for re-casting, it is frequently discovered that they have been cracked in the crown by the oxidation of the piece of iron cast in them, from which the clapper is suspended. A bell cast on my plan would never thus become cracked.

Mr. R. C. Nichols, Visitor, read a paper containing some investigations into the nature and amount of the dynamical forces arising during the motion of a large bell, and proceeded to explain certain formulæ which he had obtained for the direct strain upon the bolt or bolts supporting a bell in motion; the vertical thrust and horizontal strain upon the gudgeons; the transverse strain upon the bolt or bolts supporting a bell during the motion; and the greatest amount of strain on any part of a cylindrical section of the top of the bell measuring the tendency to tear out the boss.

In a previous discussion the direct strain upon the bolt or bolts supporting a bell in motion was stated to be six times the weight of the bell, but it would be found that in actual cases the greatest direct strain rarely, if ever, exceeds four times the weight. With respect to the vertical thrust and horizontal strain upon the gudgeons, the latter is of importance, as the measure of the force tending to pull the framing to pieces and to cause oscillations of the tower.

The amount and direction of the horizontal strain undergo remarkable fluctuations during the motion of the bell. It is at first a thrust which becomes a maximum at an angle with the vertical of 26° 44′—diminishes to nothing at 48° 11′; increases again to its greatest value at 124° 3′, and again becomes nothing at the lowest position; passing through a series of values equal and opposite to these as the bell ascends on the opposite side. The equation for the horizontal strain indicates one advantage obtained by letting the bell into the stock, namely, the diminishing of the horizontal strain; the importance of which fact will be appreciated by architects.

The transverse strain upon the bolt or bolts supporting a bell during the motion is for a bell hung on Mr. Baker's principle, and perhaps in most cases, of even greater importance than the direct strain. It is at its maximum value in the horizontal position of the bell.

The effect upon the bell tending to produce fracture is a combination of the effect of the direct and transverse strains. The measure of that tendency is the strain per superficial inch on that part of the section of the bolt which is subjected to the highest tension. The greatest amount of strain on any part of a cylindrical section of the top of the bell, measuring the tendency to tear out the boss, is represented by a similar equation.

These formulæ being applied to the case of a bell of 2 tons weight, represented by Mr. Baker's model, the maximum direct strain on the bolt supporting the bell is found to be 12,231 lbs. or 5 tons 9¼ cwt., or less than three times the weight of the bell; the maximum horizontal strain on the gudgeons 5497 lbs. or about 2 tons 9 cwt. The moment of the transverse strain at the top of the boss is equal to that of a weight of 1439 lbs. acting through the centre of gravity of the bell, and is therefore somewhat less than one-third of the effect which would be produced by the weight of the bell if sustained in a horizontal position by means of a force applied to the wheel or stock. The greatest strain per superficial inch which would arise in any part of the section of the bolt during the motion of the bell would be, with a 4 inch bolt, 7486 lbs., nearly 3 tons 7 cwt., about one-eighth of the breaking

strength of wrought iron. The maximum strain, per superficial inch, on any part of any section of the top of the bell, the thickness of the top being $1\frac{3}{4}$ inch, the diameter of the boss 9 inches, is 548 lbs.

The breaking strain of bell-metal being taken at above 10 tons per inch of section, there can be little danger of tearing out the boss.

In the 5 cwt. bell exhibited at Paris by Mr. Baker, the weight of the bell and clapper is about 567 lbs., and the greatest direct strain on the bolt 2126 lbs., nearly $3\frac{3}{4}$ times the weight, the maximum horizontal strain on the gudgeons 1162 lbs. The transverse strain is little more than one-eighth of that which would arise if the bell were forcibly retained in a horizontal position by a pressure applied to the wheel or stock. The maximum strain per superficial inch, arising on any part of the section of the bolt immediately above the boss, is 1821 lbs. or about $17\frac{1}{4}$ cwt. The maximum strain on any part of the crown of the bell is 346 lbs. The small amount of transverse strain, in this case, compared with the other, arises partly from the comparative lightness of the stock and wheel (about one-eighth of the weight of the bell, while in the former case their weight was nearly one-fourth), and partly from the bell being less sunk into the stock.

Without applying the formula to more cases, it may be considered sufficiently evident that bells may be hung with perfect security in the manner recommended by Mr. Baker. Whatever may be the strain upon the bolt, its dimensions may be proportioned accordingly, so as to give it any required strength, and it should be observed that its power of resisting the transverse strain, which is the most important one, increases with the cube of the diameter.

Bells, however, which are not intended to be swung require much slighter support, the strain being limited to the dead weight of the bell. If this were not the case, the proposed mode of hanging the great bell at Westminster would be very objectionable. It appears that it is intended to rest with a flange on a number of hooks made at the ends of bolts. Now, every one is aware that a bent rod of wrought iron will straighten with a strain many times less than that sufficient to rupture it. Still, provided these hooks be sufficiently numerous and strongly made and I do not suppose that the bell would be actually unsafe. Although Mr. Denison has not expressed a very flattering opinion of Mr. Baker's system of bell-hanging, he has paid Mr. Baker the highest compliment by adopting the essential principle of his invention. With a view to remedy the evils resulting from the clapper constantly striking the bell in the same point, Mr. Baker proposed to hang bells upon an axis, in such a manner that they might be readily turned round so as to present in succession to the blows of the clapper every part of the sound-bow. He recommended that this should be done by hanging the bell upon a single central bolt, certainly the simplest and best mode of effecting the object, but in the specification of his patent, he also claims the hanging of a bell upon an "axis cast on to the top of the crown." This is the mode adopted by Mr. Denison. The details of his plan, of which Mr. Denison's is by no means an improvement, are not described in Mr. Baker's specification, but the general principle of suspending a bell upon a circular projection or axis in such a manner that the bell may be turned round, is most distinctly claimed.

Mr. Ashpitel, Fellow, said that his system of fixing the bell-cage in the tower had not been correctly described by Mr. Baker. In the first place he fixed strong stone corbels in the walls of the tower; upon these the main girders, keeping the ends two inches clear of the wall, to allow them sufficient play. On them he placed the framed floor, and upon the boards of the latter he directed the bell-hanger to lay the bell-frame or cage, with loose bolts dropped through it into the timbers below, to keep the whole from surging. He entirely concurred in the remarks of Mr. Denison. Bells should be considered first, as single bells—secondly, as forming part of a peal or chorus, or a double quartett when there were eight in a peal—and thirdly, as carillons or chimes. Mr. Denison had truly observed, that the old fashioned form for a bell had never been surpassed, provided it was of a reasonable size,

and the waist had a sufficient sweep. The flower-pot shape, or anything approaching it was bad, and produced what might be described a growling tone. The bell of St. Peter's, Rome, too nearly approached that form. The gong, under certain conditions, was musical, but beyond a certain point the sound became discordant and dissonant, the rattling vibrations counteracting each other. Mr. Denison had stated, that in the present day with a view of saving metal, the lower bells were made too light and too deep in tone; but he (Mr. Ashpitel) would suggest whether, by calculating these matters too strictly, they might not be likely to get peals in which the upper bells would be too weak, and the lower bells too noisy and bawling. A peal of bells should be regulated on the same principle as the instruments in an orchestra. In the orchestra of the Philharmonic Society, there were eight double basses to thirty-two violins, and if there were as many of the former as the latter, the sound would be "all bottom." In the case of carillons or chimes the upper notes must predominate, just as the accompaniment is subdued at a concert to allow the air to be heard clearly. The Royal Exchange bells had this defect, the upper bells, which should give the air, could not be clearly heard. Messrs. Mears had stated to him (Mr. Ashpitel), that the Royal Exchange bells were as good as any ever cast, having been made according to the traditions of the trade for centuries; but they stated when a subdued bass note was required to fill up the harmony, it was found that the same force of blow was given by the machinery upon the lower bells as upon the upper ones. As nearly as he had been able to follow Mr. Nichols' explanation of his formulæ, he thought that gentleman had forgotten the effect of the centrifugal force in ringing bells.

Mr. Nichols explained that he had duly allowed for the centrifugal force.

Mr. Ashpitel had observed so, but not as he could see with regard to the torsion on the suspending bolt, caused by the centrifugal force; in other words, he was afraid that bells hung on Mr. Baker's plan would be severely tried by the rending force upon the swing. In the old fashioned way of hanging it by canons, the bell was grasped in a number of places; and it seemed almost impossible that any centrifugal force could rend it. Mr. Denison's method of hanging bells appeared well adapted for such as were fixed, but not for those which required to be swung. The *pitch* of the sound of a bell, whether A, B, C, or D, &c. in the gamut, depended on the *number* of vibrations in a second. In Euler's time that of the lowest CC on the violoncello was 118—since he wrote, concert pitch has been raised, and the number of vibrations producing the CC are increased. The next question is the *quality* of sound, or whether a rough noise or a musical sound is produced; this depends on the *equality* of the vibrations in point of time; in other terms, whether the vibrations were isochronous, and this results from the solidity of the material. A bell containing a flaw, or a violin string a little frayed, will not give regular vibrations, nor a pleasant tone. Another condition was the *loudness or softness* of the tones, and this depended on the *intensity* of the vibration—the harder the bell was struck, or the further a string was pulled back. The note in point of pitch would be the same, A, B, or C, and the *force* of the vibrations would cause the forte and piano.

Mr. G. Foggo, Visitor, referred to Réaumur's experiment shewing that sound can be produced by a hemispherical mass of lead cast in a ladle. Mr. Smith's remarks on the amount of sound given by solid bodies as compared with hollow forms were very interesting, and it was satisfactory to know that Mr. Denison's mind was open to conviction.

Mr. Ferrey, V.P., gave some explanation of his remarks on the injury sustained by towers from bell ringing. Many towers, no doubt, had been so badly built that the effect from that cause had become very serious. The tower of St. Mary's, Taunton, for example, had a mere rubble wall with thin ashlar, and the building had consequently suffered materially and was now in danger. But in other buildings the same defects had arisen from the negligence of those who had charge of the bells. If, however, the bell-framing was properly adjusted, if the bells had free and proper action, and were

properly placed together, no injury whatever would accrue to a well constructed building. In the case of Bell Broughton church, two bells were added to a peal a few years ago; the framing for these was placed upon the original one; and instead of making them act independently of the walls, timbers were introduced strutting across from side to side of the base of the spire; the oscillation of the bells very soon caused an abrasion of the ends of the timbers, which became in fact so many battering rams acting upon the masonry; and moving in different directions they so shook the whole fabric, that it was necessary to take down and rebuild the upper part of the spire. Some churches in Surrey contained interesting bell-cages, built from the floor of the church upon stone cushions and not connected with the masonry. He saw no reason why the present mode of hanging bells should be changed, but it was necessary that they should be properly looked after and not left in the charge of ignorant and careless men.

In answer to an inquiry whether a continuous corbelling to carry the belfry floor was preferable to single corbels,

Mr. Ashpitel described the modes of corbelling which he considered best under different circumstances. The main point was to avoid that impinging on the sides of the tower so well described as the battering ram system. In the central tower of the Abbey Church of Pershore, a churchwarden, considering the fabric insecure, had the bell-frame wedged up to such an extent that the tower became cracked and shattered in all directions.

Mr. Denison, Q. C., Visitor, observed that the leaden hemisphere, referred to by Mr. Foggo was perfectly familiar to him. With reference to it and the mason's chisels, shown by Mr. Smith, the question was, whether more sound could be got from a solid mass, or from a hollow body containing the same weight of metal; and he had no doubt the result was in favour of the hollow form. He had not the smallest objection, as he had before stated, to any person adopting Mr. Baker's method of hanging bells, but after talking with many bell-founders and some bell-ringers, and after hearing the opinions expressed now, and in the discussion last year, he had pretty good reason to believe that that method would not be adopted. Mr. Baker or his friends had asserted that he (Mr. Denison) had adopted Mr. Baker's principle; and to prove it they quoted three lines of that gentleman's specification, viz.—"My invention consists in hanging such bell upon one bolt or axis." The drawings before the meeting would show that he had not adopted that method, as the central bolt in his (Mr. D's) plan was used only to sustain the clapper, and was so small that it could obviously have nothing to do with carrying the weight of the bell.—"For which purpose I fix a bolt through the crown of the bell, or cast the bell with a tail or projection, which I fix in the stock."—Neither of these methods, as the drawings proved, had he adopted. Therefore, if the question of piracy should arise, he advised Mr. Baker to save his money and keep clear of litigation. Mr. Denison then referred to the "setting up in the stock," and to the ringing of the bells at York and Erfurt, as mentioned at the last meeting. Mr. Baker, by a certain amount of calculation, endeavoured to prove that it was easier to raise a bell when it was set up in a stock; but the question was, whether by doing so certain conditions of friction were not introduced, which would interfere with the raising, and more than counterbalance what was gained in the way of counterpoise. He never knew any case of friction that could be determined otherwise than by experiment. Mr. Airey, the Astronomer Royal, had calculated the friction in the wheels of some clock-work, but the result proved that he was deceived, as he (Mr. Denison) had predicted. Now he did not take any credit to himself for being able to calculate the friction better than Mr. Airey, but in all these matters there was a sort of instinct, or rule of thumb, the result of experience, which was better than any amount of calculation. Mr. Baker gave instances of bells in London which were improved by being re-hung and set up in the

stock; but the result might have been due to something else. He had mentioned a bell of 36 cwt. which one man had rung for four hours, whereas it took three men before;—but why should a bell of that weight ever have required three men to ring it. The very fact that it did so, proved that the case was worth nothing. Mr. Baker had not correctly represented what he had said about "sliders." He had in fact stated that they might be bits of sticks and he said so because, when he began bell ringing, he found that he broke a great many stays, and he soon came to the conclusion that, by breaking sliders instead of stays, he should save money, and therefore, in fact, the sliders were made of sticks, and they were more easily manageable and lighter, as well as cheaper. The sliders were light bits of stick instead of heavy ones. With reference to the Westminster bell, he admitted that it would be more easily turned by Mr. Baker's plan than by his own, but the question was whether it was worth while to adopt Mr. Baker's. He would not argue that question, but would simply state that those whom he had consulted thought it was not. He did not himself care about it, if Sir B. Hall liked to incur the expense. Certainly he had never yet seen a bell worn out by a clock hammer, nor even worn to the depth of half an inch, though many had been worn out by the clappers. And moreover, clock bells would not require turning in four times the time that it would be necessary to turn a bell rung with a clapper. The Oxford bell was a good deal worn by the clapper inside, but not to the extent of half an inch by the clock hammer. Whether from the flatness of the hammer or the steadiness of the blow, he did not pretend to say, but such was the fact.

Mr. Varley, Visitor, alluded to the mode in which gongs were hammered alternately on both sides into a state of extreme tension, and to the peculiar snapping and crackling sound given by those instruments when struck. It would be impossible to make a musical peal of gongs, or to tune them so as to get a series of notes or musical tones. Mr. Varley also mentioned the noise produced by letting fall a flat tea tray. With regard to Bow Church, he mentioned that on going up the tower with Mr. Gwilt, he observed two of the pillars of the peristyle were broken, and that bell-metal bands were put to hold them together. He wished to know whether these columns were cracked by the vibration of the bells, and whether it was not consequently dangerous to ring them.

Mr. Ashpitel, with reference to the noise produced by a tea-tray, alluded to the "thunder" at theatres, made by shaking a long sheet of metal. The object however in bell-founding was not merely to produce a noise, but that noise which could travel furthest.

The Chairman (Mr. Tite, V.P.) explained that the fracture of the columns in the tower of Bow Church had arisen from the introduction of iron plugs in the joints, which had oxydated and burst the stones. To remedy this, the broken shafts had been bound round with bands of gun metal; but as there was a heavy dome resting on these columns, Mr. Gwilt had afterwards taken them away and replaced them by granite shafts in one piece. He knew no reason why the bells should not be rung. There was an impression that it would be dangerous, but he believed it was erroneous. He had himself been on St. Dunstan's in the East, above the arches, when the bells were ringing, and had felt the whole place vibrate, but the bells had been rung ever since the Fire of London without substantial injury, although he had several times repaired the arches from accidents arising from the same cause as at Bow Church, namely, the oxidation of the iron plugs.

Mr. Fowler, Fellow, suggested that the use of copper instead of iron bolts would not be attended with the same evil.

A Visitor observed that the theory of producing various degrees of pitch of sound from bars, plates, and other forms of metal had been well known for ages. The theory of the subject was also perfectly correct with reference to the loudness of the sound being dependent on the extent and number of the vibrations in a metal bar or a string; but with respect to the *quality* or *timbre* of

the sound, that was not so well understood, either in plates, bars or bells. The *volume* of sound as distinct from *loudness* was not at all clearly explained, nor the property which enabled sound to travel quickly and to a great distance. The sound of a bell was certainly louder when it was waved; but only when the bell was moved *towards* the hearer, and not during the reflex action.

The Chairman regretted he was not present at the former meetings, as he felt much interest in the subject, having been blamed for the failure of the Royal Exchange bells, over which he had no control. He agreed with the last speaker as to the importance of *timbre* or quality of tone. At the Royal Exchange they had never succeeded in getting the bells in tune. There was a certain scale of notes which were intended to play tunes, and therefore should have been properly pitched. There was no particular necessity to study expence, and he had been anxious to get a good chime of bells. At Messrs. Mears's works, he found a rude system in operation, which appeared inconsistent with anything likely to ensure tune. He saw indeed that the whole matter was traditional; and he therefore suggested that bells so roughly cast could hardly be in tune; and he further proposed to put the series in a row, and by striking ascertain whether the gamut could be produced. This trial, however, was declined. The machinery for the chimes was made by Mr. Dent, one of the most skilful mechanicians in the world; but as soon as they began to play, the effect was highly disagreeable. In fact the peal was not in tune. Then came a series of suggestions, such as "the hammer strikes too hard," but as Mr. Dent said, it was easy to make it strike softer, by merely shortening the lever. The architect and the tower were in fault, indeed, it was anything but the bells; but in fact the tower contained a large square chamber, with four large windows filled with louvres, &c. He even offered to take the louvres away. At last it was agreed to take down the bells and re-cast them of a larger size, and with two additional bells; but the new bells failed. It was plain that the makers had no rule; yet they produced testimonials without number, and engaged that the bells should be in tune to the satisfaction of Mr. Edward Taylor, Gresham Professor. At first they insisted that the bells were in tune, but Mr. Taylor tested them with a violin to show that there could be no possible mistake. The bells were chipped, cut and altered in every way without success, and he (the Chairman) never could get people to believe that *tone* was not *tune*. Mr. Taylor, of Loughborough, re-cast the bells, but without success, and he believed the chimes remained a failure. He had found in an old manuscript an illumination showing a man grinding bells, and he believed that the ancients in fact turned the inside of their bells in an accurate form with regard to the outside, according to some rule now lost. He believed that the same law or mathematical process by which he had seen Erard set out the top of a harp, might be applied to a bell, so as to conduce to its accurate tuning in any particular note. He had heard the traditional story that the founder of the tenor bell of Bow Church never left it, but was always filing or hammering the inside till he got it to the proper note or pitch of the C of that time. The Chairman further observed that a letter had appeared in the *Times* stating that the Westminster bell could not be got into the clock tower, as Sir Charles Barry had forgotten to provide an access for it. It was due to Sir Charles Barry to state that this was not correct. He had not forgotten the matter, nor was there any difficulty in it; neither would it cost £3000. to erect a scaffold to raise the bell. The meeting was aware that the whole of one side of the lower story of the clock tower, facing West, consisted of a large arch, which had been filled up with brickwork; the bell would be brought up to the arch, and so much of the brickwork removed as might be necessary, and the bell would then be raised without any difficulty whatever.

The Chairman then adverted to and explained some of his remarks made at the opening of the session. The meeting afterwards adjourned.

SOME REMARKS MADE AT THE ORDINARY GENERAL MEETING OF THE ROYAL INSTITUTE OF BRITISH ARCHITECTS, February 11, 1856.

Mr. Tite, V.P., having closed the discussion on the subject of Bells, proceeded to say—As I have had the honour of occupying the chair to-night for the first time for many weeks, I am anxious to take the opportunity of putting myself right with reference to some remarks which I made in the discussion on the diploma question, on the undue preference (in my opinion) given to Mediæval Architecture, and which remarks have been somewhat misunderstood. I was an early cultivator of Mediæval architecture; I esteem it very highly, and I think I understand it; but all that I wanted to urge was that it was not reasonable to abandon the better styles of architecture (for many purposes) for what I considered the fashion of the day. That the study of classical architecture is neglected is proved by the fact that there have been no competitors for the architectural medals of the Royal Academy, as stated by the Professor in a recent lecture—now why is that? Surely because the young architects of the day are studying Mediæval Church architecture to the abandonment of other studies, and I presume, therefore, until the Academy can be induced to give a medal for a design in that style we shall have the same result. Such a state of things I greatly regret, because classical architecture gives us the best and most certain principles of feeling and thought in architecture. With regard to Mediæval architecture, it is true we have become good copyists, but our fore-fathers did vastly more than this, for they urged on their thoughts and inventions—they went on from excellence to excellence, and they often obtained it in the search after novelty. Young architects should study the principles of things, and apply them to expression, utility, and fitness in architecture. In the remarks to which I have referred, I found fault with the unfitness of modern Mediæval churches for the purposes for which they were built. I quoted one which, although elegant and beautiful, was anything but a Protestant church. I stated, amongst other things, that on the south side of the deep chancel of that church, there was a range of sedilia. Now of what Protestant use could they be? The rubric says the minister shall "stand on the north side of the altar,"—and even among Roman Catholics they are obsolete. Such ornaments are not only useless but expensive, and inconsistent with the purposes to which the churches are applied. Then again I have seen lately in two large squares near Belgrave-square, large masses of building in which classical architecture would have given a better church than those which have been built there. I allude to Warwick-square and Chester-square, composed of masses of regular Italian buildings; and forming one side of each square irregular Gothic churches with spires are placed, which appear to me incongruous and out of place; and inside they are not adapted to those vast congregations which frequent them. That these are the opinions of men as well able to judge as myself, is proved by the remarks of Mr. Petit, the learned Ecclesiologist. He says,*—"There are good reasons why we should rather make the best of our old churches, than materially alter them or destroy them to build others in their room: the impression they are calculated to produce more than compensates for some inconvenience in their form or arrangement; but there seems no reason why we should ever plan or build a new church of an inconvenient form, or in any way unsuited to our own manner of worship. If, for instance, it is desirable that all the congregation should be within sight and hearing of the minister, why should a church ever be built in which a part of the congregation is hidden from him

* *Vide* Builder, January 26, 1856—Mr. Petit's Address at the Architectural Exhibition

when he performs any part of the service in the usual place? And this must be the case in every church having aisles which terminate at the division between the nave and chancel. If we find that galleries are useful and convenient, why should we build churches that will not bear galleries, or to which they are a disfigurement? If we professedly adopt high-pitched roofs as suitable to our climate, why should we ever combine them in such a manner as to leave a lodgment for snow or rain? There may be difference of opinion as to the advantage of an unbroken area, or the expediency of galleries; still they serve my purpose in illustrating the proposition I would advance, which is, that an architect ought not to abandon a convenient arrangement on account of its ugliness, but rather try to get rid of the ugliness without giving up the convenience. If, then, a feeling that his first object is to make his building fully answer its primary purpose, and a determination that nothing shall be allowed to interfere with this object, be referable to a spirit of utilitarianism, I conceive that so far, at least, an architect ought to be a utilitarian."

That is the opinion of a modern Ecclesiologist of great learning and judgment; but I will quote also the opinion of Sir C. Wren. He was called upon to build the City churches, and he gives this opinion on the subject.* He says—"Churchwardens may be careless in speedily repairing drips, but they will usually whitewash the church and set up their names, but neglect to preserve the roof over their heads." He next proceeds to discuss the capacity and dimensions of the proposed new churches, and a mode of calculation to determine them from the number of inhabitants for whom these churches were to be built, which he calculated at four hundred thousand, or five times as many as were burnt out in the City. The churches, therefore, he says, must necessarily be large, and if they were built to hold two thousand persons each, the accommodation would fall very short of the requisites, but, he adds, in our reformed religion it would seem vain to make a parish church larger than that all who are present can both hear and see the preacher. The Romanists indeed may build larger churches—it is enough if they hear the murmur of the mass and the elevation of the host, but ours should be fitted for auditories. He considered it to be hardly practicable to make a single room so capacious, with pews and galleries, as to hold above two thousand persons, and all to hear the service, and both to hear distinctly and see the preacher. He endeavoured to effect these objects, he says, in building the parish church of St. James, Westminster, which he presumed was the most capacious, with these qualifications, that had then been built; and yet at a solemn time when the church was much crowded, he could not discern from a gallery that two thousand persons were present.

I was rather more urged to express the opinion I did, by not desiring to see classical architecture neglected merely in obedience to a present fashion. I believe that fashion will to a certain extent pass; I may be mistaken, but it appears to me that the universal application of Mediæval architecture and forms is an error and a great mistake. I simply suggest that as my opinion, and I regret that that which formed so important and so necessary a subject of study in my early life should be at the present day neglected for something which, though beautiful in its way, has not so many claims upon our attention, and is not so well adapted to our forms of religious worship. I have no desire whatever in the least to interfere with the views of others, but those who choose to adopt those views conscientiously will find in me a man to think for myself. I am glad to have this public opportunity of saying a word upon this matter, because by one of our most eminent professors of architecture I have been a little misunderstood. I only offer this as a matter of explanation and not of discussion at the present moment.

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* *Vide* Elmes' Life of Wren, and the Parentalia.

A REPLY TO SOME REMARKS MADE AT THE ORDINARY GENERAL MEETING, November 19, 1855.

To the Honorary Secretaries of the Royal Institute of British Architects.

My dear Sirs,—

I intended to be present at the meeting this evening (but was prevented by a slight indisposition) to offer some few words in reply to the remarks reported in your printed notice of the previous meeting, as having been made from the Chair, by our respected Vice President, Mr. Tite, on the subject of the revival of Pointed Architecture.

In a society which supposes each of its members to hold his own individual opinion, and to express them freely as he pleases, it may appear unnecessary to notice mere manifestation of feelings which every one knows our respected friend entertains; but coming *ex cathedrâ* from the Chair of our Institute, and from our parliamentary representative, they may, if unanswered, appear to acquire more weight than belongs to them, and be viewed not as the feelings of an individual member only, but as those of the Institute as a body; in which case it would naturally become the duty of those who hold contrary opinions to make a formal protest, or to separate themselves from the Society.

Mr. Tite contented himself in his address at the preceding meeting with a general expression of regret that the love of Pointed Architecture was becoming too exclusive, but with some compliments to its favourers on their success as compared with their fellow-labourers in France. He commences his second series of remarks with a somewhat stronger expression of his regret, especially that we do not keep ourselves to the buildings for which our style is suited; warming as he proceeds, he accuses us of being mere blind copyists, incapable of thinking for ourselves, and winds up by showing that our style is unfit for any purposes at all unless it be for Roman Catholic churches. Now, would it not have been better to have acknowledged this opinion at the outset? We can readily understand that the majority of those who were firmly grounded in the old state of things before our movement had made much progress, are likely to disapprove of what we are doing. It is so with every movement, whether in Art, Science, or Politics; the movement party are invariably maligned and opposed by those whose prepossession they disturb. It is an understood thing, and no one wonders at or complains of it. Mr. Tite, however, takes a higher ground; he admits at first that in some respects, and in some cases, we are right, and meets us on this ground; but at last winds up by denying that we are in the right anywhere, unless it be in Roman Catholic churches!

I will, however, crave your patience while I follow him into particulars. His first complaint is that our style is applied "to buildings for which classical architecture is more fitted, such for example, as town halls and markets." I rejoice to hear that there is such cause of complaint! *I* have long been complaining that it was *not* applied to such buildings, for which it seems to me so eminently adapted. Where, for instance, are finer town halls to be found than in the great Mediæval cities of Germany and Flanders; and where better market houses than the *halles* of the Flemish towns? They are only too good and too noble for us; but surely a style which produced *them*, and which has produced equally appropriate buildings for the humblest purposes of trade and husbandry, will not fail in giving us such modifications of its nobler conceptions as will meet our circumstances, whatever they may be. Only give us the chance, and I think we can show whether town halls and markets are unsuited to our style.

Mr. Tite next complains that in building churches in towns we do not respect the style of the "elegant" houses adjoining. I sincerely wish we could say much for the elegance of our town houses! They certainly carry out Lord Bacon's axiom. If they are built *to live in*, they assuredly

are not generally built *to look at;* though it is the misery of our lot that we are hourly compelled to look at them! Be this, however, as it may, it is inherent on a period of change that such discordances of style should exist. The architects of the seventeenth century did not scruple to build in their own Renaissance style because surrounded by Gothic buildings; they even patched up the latter in their own style. No change would be made in anything were this principle to be admitted. It is simply the principle of obstruction, which comes ill from the Chairman of an Institute like ours, which professes to aim at progress.

If, however, our Vice President merely means that we build in our *towns* churches better suited to *rural* situations, I heartily join with him; but is this his own criticism? has he not, or might he not, have learned it from ourselves? I can refer him to able articles on the subject from the pens of leading members of our movement, in which he will find it impartially discussed, and our errors severely exposed. Surely, he will hardly venture to say that Gothic architecture is suited to the country but unfit for towns!* that it is unsuited to be placed near houses 70 or 80 feet high! I confess I have never heard want of height quoted as one of the defects of Gothic architecture. I do not know whether he refers to the church in Gordon-square as being unfit for such a position, but if he will look out from the side of Hampstead-hill, he will find that this *alone* among all the churches of London (St. Paul's and Westminster Abbey only excepted) is seen rising predominantly over the house-tops, and is a conspicuous object without the aid of a tower. All that keeps us from raising our town churches above the "elegant" houses around them is *our poverty;* a hindrance which would apply equally to any style; excepting that a Gothic church would be vastly improved if we could afford to make it tower above our houses, while an Italian church would probably be thrown out of all proportion by the operation. Our misfortune is independant of our style. We are compelled to build *town* churches with *country* means, and are then laughed at for building country churches in our towns. If we had the funds which were expended a few years back on some of the worst of our "classical" churches, we should not dread the proximity of houses 70 or 80 feet high, nor fear to be accused of building churches only suited to the country. But even if we have in some cases deliberately fallen into the error (which I think has sometimes occurred), that has nothing to do with the style, for no one will accuse Gothic architecture of falling short of the *classical* in *loftiness.*

Mr. Tite then proceeds to compliment the builders of some of the great City warehouses, and further on imagines what some Gothic architect would have made of them. Has he ever seen the *noble* and almost *majestic* Mediæval warehouses in some of the ancient German cities? A nobler type for buildings of their kind can hardly be conceived: they have rather too much roof for modern purposes, but are designed with a perfect appreciation of their use, and obtain their noble aspect solely from the simplicity and truthfulness with which their uses are provided for. Some of the finest warehouses I have seen in England and Scotland, built by persons who never thought about building in any style, but simply thought of doing *well* and *efficiently* what they were about, have struck me as having a strong family likeness to these stern and noble structures; and they certainly look better than the huge, over-corniced, though handsome, fronts in the city of London. It is curious that while Mr. Tite lauds our City warehouses in the same breath in which he speaks of the *small projection* in French street architecture, as showing that their architects lean "to the wants of the place and the times," Mr. Fowler very justly complains of their enormously projecting cornices as reducing, in narrow streets, the sky as seen from the street to one half! He might also have animadverted on the *frightful danger* they incur.

* It is an unfortunate admission on the part of our opponents that Gothic architecture, while it harmonizes with the works of God, clashes so severely with the modern works of man.

After some very judicious remarks upon *fitness*, and on making a building suitable to its purpose, sentiments which, by the way, he will find admirably enlarged upon by Mr. Pugin in several of his works, and laid down as the key note of Gothic as distinguished from *modern* architecture—Mr. Tite returns to churches, selecting one which he has seen in the neighbourhood of a manufacturing town as a beautiful piece of copying, but as failing in all its practical uses. Surely, however, he will not argue that the mistakes of an individual architect are to be taken as condemnatory of the style he happens to be working in; or what style would escape? "The congregation *could not hear;*" but, is this usually the case with Gothic churches? The very reverse is more frequently the fact. Nor could they "*sit with comfort;*" but, surely a seat may be made comfortable or uncomfortable in any style! There was "*no ventilation;*" but is Gothic architecture opposed to ventilation? The "*warming* was defective"—surely a few more hot-water pipes would not have marred the style! "The clergyman *complained of the reading-desk*"—what clergyman does not complain of his reading-desk whatever be the style? It is said that every new incumbent of every church wishes to inaugurate himself by moving the pulpit; then why not complain of his reading-desk? Let him alter it to his mind, and it will not, I dare say, be less "Gothic" than at present, or less like what it would have been in Edward III.'s time! "Indeed the church is so inconvenient that *the people would rather stay away than go to it*"—but this may be the fault of the people and the clergyman as much as of the church—yet after all this, the church is "far more beautiful than the architects and masons of Edward III.'s time *could have made it!!!*" Really this *is too* complimentary! What! more so than *Exeter cathedral;* than *St. Stephen's chapel;* than the west front of *York;* than all the churches of Lincolnshire, or the church of St. Ouen, or the façade of Rheims?" If so, I do pity the taste of those who would rather stay away than go to it! I would willingly bear a little cold, or sit in an uncomfortable seat, for the luxury of seeing such a building!

Now, I think, I happen to know the church alluded to. It is, if I am right, a very nice simply designed church. It is generally (it is true) in the form of an old church, but is absolutely free from slavish copyism; instead of being a most accurate and elegant imitation of the style of Edward III, it comes home to my recollection as a somewhat severely simple adaptation of that of Edward I. Instead of being far more elegant than the old people could have made it, all little elegancies of workmanship are carefully eschewed. It is rather ascetic than elegant in its character. Instead of being a specimen of "*identical copying*" and having "no ventilation," it has the novel feature of the clerestory devoted to newly constructed ventilators in lieu of windows. Its seats are unquestionably faulty, as much an exaggeration of *lowness* as the seats of thirty years back were of *height;* and the hot water apparatus (whether or not from being constructed as a type of Edward III's days) does not answer. My own impression was, that this arose not from the style of the apparatus, but from the engineer having been chary of his pipes. There are possibly a few ritual affectations about the chancel which would be as well modified; things which usually depend more on the fancy of the clergyman than the architect, and certainly have nothing to do with the style; one thing however I observed, which I much liked—a large and cleverly contrived recess in the chancel for the organ, such as I have never seen in any church ancient or modern, and which certainly did not strike me as a specimen of copying or of "*want of all thought.*" The clergyman, however, not only complains of his reading desk, but of his pulpit. "Being made of stone it is so cold he cannot put his hand upon it!" Did this ingenious priest never think of the expedient of lining the top with cloth or velvet, which is usual even with wood pulpits? Surely a pulpit may be made either of wood or stone, whatever be the style of the church! It is usual to give the clergyman his choice, and I generally find them choose stone, forgetful of their hands; and among old pulpits I think I have seen more stone or marble ones of the Renaissance than of the Mediæval periods,

and I do not at this moment recollect any of the time of Edward III. The last complaint is described "as a most enormous mistake;" it is that the altar rail only allows room for twelve communicants. It may be better to allow more, but if Mr. Tite will look into it at such a time, he will find that it really makes no practical difference, or very little, whether the rail be long or short, if the rule of the church be carried out of repeating the words prescribed to *each communicant*, or even to two together. If however the indecent custom be admitted of repeating them only to each "rail" of communicants, I admit that time is saved by making the rail long, but it is a custom more honoured in the breach than in the observance. Finally, however, we come to the "sweeping clause," which condemns all the forms of Gothic arcitecture as suited to the Roman Catholic religion and unsuited to our own; and on this ground, in Mr. Tite's *sincere opinion*, he thinks "the architecture which was learnt in Italy was much better suited than that now in fashion." So we are to go into Italy to learn Protestantism! The Popes then were sadly mistaken when they built St. Peter's! Little did they think they were erecting the type of Protestant architecture. I will not however follow out the subject, the fallacy of it is too obvious.

One word however on the subject of copyism. It is unquestionably one of the great vices of our day, and the more it is run down the better; but let us have fair play. *Laudari a laudato Viro*, is what we all desire; and we equally rebel against being blamed by those who wallow in the same mire with ourselves. Now, the classic architects have no kind of excuse for their copyism. They have been at work for three centuries and yet too often work like schoolboys; not only every detail is most abjectly copied, but they actually scruple not at copying nearly whole buildings at a time! If we are copyists, we have learned to be so in their offices, where copying is, with some bright exceptions, the sum and substance of architecture. They use *now* the very arrangement of leaves they find in ancient capitals, excepting that they fail of their spirit; even the triglyphs and guttæ, the symbols of transition from wood to stone when the Dorians adopted the materials of the Pelasgi, they copy to this day with scrupulous accuracy, and learn with infinite pains their proper proportions in decimals of minutes! and yet they have the conscience to accuse us of copying, because while learning and reviving the long neglected arts of our native country, we do not at once strike out into new developments. We have had first to make ourselves masters of our grammar, but already we develope more, we copy infinitely less, than they do after three centuries of training. I am one of those who have been behind the scenes, and have been put through all the facings of classical practice; and, while I admire genuine classical architecture quite as much as our excellent Vice-President (though I think another style more suitable to ourselves), I know too well the practice of modern classicism not to be fully aware that *ours*, with all its faults, is freedom itself compared with the copyism which preceded it. Our aim is *not to copy* but to *develope*, and to render our style the truthful expression of the wants and circumstances of our day; and to effect this great object will be the constant aim of,

My dear Sirs,

Your faithful Servant,

GEO. GILBERT SCOTT.

Avenue Road, December 3, 1855.

ARCHÆOLOGICAL STUDIES IN JERUSALEM,

By George J. Wigley, Associate.

Being Observations made at the Ordinary General Meeting of the Royal Institute of British Architects, February 25th, 1856.

Using the word Archæological in the French sense, I do not propose to treat of the topography of Jerusalem, but to limit my observations to the architecture of the past, in giving you the results of a year and a half's study; to which much might be added by further residence. I accept, without further remark, its traditionary topography, which is that of all ages, and has been well elucidated by the late Dr. Schultz, Prussian Consul, by Mr. Williams, and still better by Professor Willis, a master in archæological analysis.

There are three periods which may have influenced the architecture of Jerusalem, and which your knowledge of history will readily enable you to determine. The first is the *Jewish*,—the second the *Byzantine*,—and the third that of the Crusaders, or the *Latin* period. I shall make no allusion to the Mahomedan specimens of architecture in Jerusalem, as they are not so much connected with our immediate studies.

With regard to the Jewish period, it is difficult to find anything like ornamentation in the monuments of that time. We judge of western architecture by such marks, but in Jerusalem we are at a loss, though we find here and there a few Egyptian-like features, chiefly in the cornices of tombs, such as those of Zachariah and of Absalom.

I may state here what an ancient Jewish tomb is. The arrangements characterise it more than the detail. A large Jewish tomb consists of a porch from 3 to 6 yards in width, 3 or 4 yards in height, and sunk to the depth of 2 or 3 yards in a wall-like face of rock. In the middle of the porch is a very low doorway—something like the opening of a fire-place, through which we creep, and enter the funeral chamber, containing the "*loculi*," or places on which to lay the bodies, as on couches. Jerusalem is surrounded by these tombs. It is the city of the dead, *par excellence*.

A more complete notion of these tombs is given by some photographs taken by myself during my residence in Jerusalem; which, with others showing various remains in that city, I now exhibit.

To illustrate the small amount of ornamentation existing in works of known Jewish origin, I may state that the two great tombs of Absalom and Zachariah display a mixture of Jewish with Roman Oriental style; but in a little tomb in the village of Siloam, we find the Jewish characteristic I have mentioned. It very much resembles the Syrian example drawn by Mr. Scoles, and illustrated by Profesor Willis in his dissertation on the Holy Sepulchre. It is a monolithic tomb, carved out from the rock, and has no porch; a small vestibule leads from the first doorway to an inner one, inside which is a small room about 10 feet square, containing a large "*loculus*," where one body could be placed, and on both sides smaller "*loculi*," on which to place the bodies of children, or lamps. The cornice consists of a deep fillet, a large cavetto, and a thick orlo.* That is the whole amount of Jewish ornamentation we can find; and the whole very much resembles Egyptian architecture.

I may here allude to other peculiar arrangements of Jewish architecture—the Pools, which are very prominent features in Palestine; such as those at an hour's distance south of Bethlehem, called the Pools of Solomon, which supplied the whole of Jerusalem with water. Springs and

* Torus.

sources of water are very scarce in Palestine, and it only rains in the winter; the water is therefore preserved for the supply of the whole summer by means of these large pools and cisterns. The pool of Mamilla is on the west side of Jerusalem, and there is another on the east, near the gate of St. Stephen, just overlooking the valley of Jehosaphat. The pools were not made merely to supply water to the inhabitants of the towns, but also for religious purposes. We have the remains of what is known as the Probatic* Pool, and I believe it is such, specially from its position with regard to the Temple. We have other pools in the vicinity of ancient temples, particularly a very large one near the entrance of the temple of the Samaritans on the top of Mount Gerizim, which is seldom seen by travellers. The Temple of Jerusalem is altogether destroyed, but we can resort to the Temple of the Samaritans, which having been a sort of copy of it, will give us some data so far as many of the details of such arrangements are concerned, which we cannot get at Jerusalem.

I will pass now to constructed monuments, having hitherto dealt only with excavated ones; and in studying these, which give so little ornamental data, we must go deeper into archæological study as architects, and learn to *read a wall;* to know the masonry, and recognize the different touches of different periods. The mason of one day does not imitate the mason of another, but he gives his own stroke of the chisel in his own particular way; he is not educated to be a good copyist, and is it singular to find how different periods are monumentalized by the stroke of the chisel, as they are in palæography by the stroke of the pen.

In treating of the study of Jewish masonry, I will begin with some data taken on the authority of a Jewish writer, who, though comparatively a modern author, knew what he was about. Rabbi Benjamin of Tudela, in 1163, speaking of the Tower of David, says, "About ten yards of the base of this building are very ancient, having been constructed by our ancestors; the remaining part was added by the Mahomedans." This therefore is a good specimen of Jewish masonry. The Place of Wailing" is mentioned by very early travellers; and Benjamin of Tudela says "In front of it (the cupola of Omar) you see the western wall, one of the walls which formed the Holy of Holies of the ancient temple, it is called the Gate of Mercy, and all Jews resort thither to say their prayers, near the wall of the court yard:" you see here clearly what kind of masonry the Jewish is, as distinguished from later masonry. It consists of stones five or six feet high on an average, and sometimes extending (as in the south-west corner of the Temple) to a length of thirty feet. The four edges of the face of each stone are rebated to form rustic joints, but the centre is worked perfectly smooth. This is also the kind of masonry seen in the monuments which we must attribute to the Herodian period. In many of these latter walls, however, the stones, though of the same large size, are perfectly smooth, without rebated rustic joints. Starting from the Place of Wailing on the west of the Temple close and going south, we come to a good piece of masonry; the arch of the broken bridge spoken of by Dr. Robertson. It is made of very large stones, and as far as we can conjecture, must be the work of Herod the Great. We see above it masonry of small stones, worked smooth, of the Byzantine period, and above that Mahomedan rusticated masonry. This is in the southern part of the western side of the walls of the Temple close. We have just come to the south-west corner of it, and now turning to the south side, we begin to find something like architectural ornamentation. It is of the Herodian period, and we may call it of the Roman Oriental style. It is evidently of the same school as the monuments of the Romans in Italy, but differs from them in being overloaded with ornament. About the middle of the southern side of the Temple, we have an old gateway (the convent which the Knights Templars built afterwards cuts it completely in half), and the lower course of stones all along the wall show it to have been entirely of Jewish origin.

* Sheep Pool.

Up to a certain height it is such; above are smaller stones, this part being probably of the time of Justinian; and above that another kind of masonry which may be attributed to the Mahomedans. This was probably the gate of the "*Prostoa*," described by Josephus as added to the Temple by Herod the Great, and which Professor Willis has completely identified from the position of the existing foundations. Going eastward along this southern side, we come to the three arches within the wall, which have been noticed by Williams and other writers. They are plain semicircular arches, evidently of the Byzantine times, yet it is a curious fact, that the western extremity of the series is placed exactly upon a jamb of the Herodian period; and the small size of the stones forming the archivolt compared with the immense size of the stones of the jamb is remarkable. The deep and thick mouldings on the jamb prove this to be an old Herodian doorway, capped by subsequent Byzantine work. The views of Jerusalem which you have seen will enable you to understand me when I speak of the south-eastern corner of the Temple close, which towers above the valley in a marvellous manner. The level of the enclosure is carried on vaultings. These vaultings I have not examined, but from the report of others, I judge them to rest on piers much older than themselves; and we may suppose the piers to have been also Herodian work, the vaulting being added afterwards, probably in the period of Justinian. Turning this corner to the eastern side, we come to another ornamented architectural feature, the Golden Gate, which consists of a double archway on piers; the arches ornamented with thick garlands of flowers, &c. We cannot so well describe the internal front, because as it is in the "Haram" (enclosure), we have not access to it. As far as I have seen it from a distance, I believe (and some illustrations from Mr. Catherwood warrant my conjecture) it is very much like the outside of the southern gate. Both fronts seem to be of the Roman Oriental style; but when we look through the loopholes in the exterior face, we see inside some much coarser work of a heavy Byzantine character. At the north-east corner of the Temple close, we see the manner in which the old masonry is distinguished from the new. The corners of the close were made more solid than the rest, and much more of the old courses of stone exists there. On the northern side of the Temple close, we have already noticed the Probatic pool; but this, like the other pools, having been restored by the modern Orientals, it is difficult to discern any old masonry in it. Passing on we come to the north-west corner, which, most likely, is the spot where the tower of Antonia stood. This tower was to some extent of the Herodian style, and here probably the second wall of the city terminated eastward. Here we begin to see some traces of masonry jutting out of the general quadrangle.

Where the Prætorium of Pilate is pointed out by tradition, we see the square of an atrium marked out by the rock being trimmed up to the masonry that was afterwards erected upon it; and on the eastern side of the present building there is a large quantity of ancient stones. The north-west corner was made by scooping the rock inside, to bring that part to the general level of the Temple close. Sometimes twenty or thirty feet of the rock were excavated to form the wall, as mentioned by Mr. Bartlett.

Here are the remains of a very ancient wall, which may be near the great stairs mentioned as having connected the tower Antonia with the enclosure, and by which the troops of Titus descended into the Temple area during the assault of the city.

On returning again to the western side of the Temple close, I have to notice two buildings still remaining. The first has the tradition of being the place of the Beautiful Gate; and the second, where the present town-hall of Jerusalem stands, is supposed to be the Chamber of Council of Josephus. These bear more the traces of genuine Roman masonry, the stones being not more than two or three feet high, and left rough in downright rustic, without any sort of plain face.

Near the north-west corner of the area is the traditional arch of the Ecce Homo. It is at a short distance from the atrium of Pilate, and is also an arch of Roman masonry. The mouldings which still exist on several voussoirs and on the impost, display the plain Roman colonial style.

We see other specimens of Herodian architecture about the town. At the traditionary spot of the iron gate we have pilasters of Roman work embedded in the wall. The medical man of the Jewish Protestant Mission having restored his house there, has confirmed the fact of considerable portions of masonry having been on the spot.

The rock tombs exemplify still better the Herodian school; among the most important of them are the Tombs of the Kings. The monument so called possesses important architectural features, and is one of the noblest royal tombs in the world. There is nothing indeed equal to it in solemnity but the recently formed tomb of Napoleon. It stands in the centre of an open Confession (in the sense we use the term in the Roman Basilicas) consisting of a court-yard sunk in the rock. Even that court-yard is divided into an inner and outer space, and is about fifty or sixty feet square. One portion of it consists of an inclined plane, divided from the rest by a wall of rock, and this communicates with the inner court-yard by a round arch, carved in the rock itself. Going northwards down this plane, turning to the left and entering the funeral yard, we have to turn again to the left to be in front of the tombs properly so called,—which are on the southern side of the court-yard. They are an amplification of the common kind of ancient Jewish tombs. The porch is adorned with an abundance of carvings in the live rock itself,—consisting of a Doric cornice enriched with bands of flowers and fruit. In the centre of the frieze is a bunch of grapes between two crowns, filling the space which would be otherwise occupied by a triglyph and two metopes. I regret to say that the central ornament now exists only in my photograph, an American traveller having knocked it off in order to take it home. There have been many suggestions as to the date of these tombs; a recent French traveller having the presumption to ascribe them to the time of King David. The photograph, however, will not lend itself to such fantastic notions; and in this respect it is the very best safeguard against the over-imaginative views of archæologists. As far as we can judge, it is a tomb of the Herodian period. We know that Herod the Great was buried at Herodium; we know where all the princes before Herod Agrippa the elder were buried; and the position of this tomb is close to what we believe to be the wall of Agrippa, and to the way which led from Jerusalem to Cesaræa, therefore close to a gate of that wall. The royal caverns are mentioned for the first time by Josephus in connection with the wall of Agrippa; we are therefore amply justified in thinking that it was part and parcel of the general adornment which King Herod Agrippa added to Jerusalem.

Another illustration of the Herodian period is the cornice of the noted tomb of the Judges. This tomb is three miles from Jerusalem; from the gate of the city of Agrippa to that spot there is a long line of rock tombs, forming as magnificent a funeral way as any in the world; quite as fine as the Via Appia, displaying indeed more thought and character, and executed at more expence. Even beyond that distance there are tombs. On one eight miles from Jerusalem, there are some fragments of a Doric cornice. In the famous tomb of Absalom an Egyptian cornice seems to crown the Roman work. Remodelling the monuments of the Jews may be fairly considered as part of the mania of Herod the Great; indeed he went to the extent of rebuilding the whole Temple for them. With this last tomb we conclude the series of illustrations of the first or Jewish period.

With the family of Herod the historical importance of Jerusalem ceased for a time, and it was only when Christianity became the religion of the Roman empire, that it again rose into im-

portance. From the time of Constantine to that of Heraclius, the whole of Palestine, and especially Jerusalem its capital, might be considered the head quarters of Christianity. It was given up by the Roman emperors to religion, and was covered with churches, monasteries, and convents. The history of that period gives as the most prominent names in the country, those of Saints Jerome, Eusebius, Paula, Saba, and many others. The monuments however are scarce. We have a church in Jerusalem, which as far as we can conjecture, is of the time of Justinian. The present mosque El Aksa, we are told, was begun by one of the Patriarchs of Jerusalem and finished by Justinian himself; this was about the middle of the sixth century. I have not been able to enter it, but I believe it has been disfigured by subsequent constructions, both during the Latin and the Mahomedan occupation of Palestine. The only authorties we can follow in the matter are Procopius and the modern views of Mr. Catherwood. It appears to be of the Basilican form, and terminates with a transept; the apse, which has been destroyed, must have been attached to the transept without an intervening choir.

At Bethlehem (six miles from Jerusalem), there is one of the most complete Basilicas of the Byzantine times. It is more than 200 feet long, with five naves divided by four rows of columns, directly united by an entablature. It has a very magnificent transept, and terminates with an apse, both at the eastern and at each end of the transept. This church is illustrated in the work of Canina on *Christian Temples*. You will there see what a marvellous instance it presents of the Greek school of mosaic art; which, however, is of later date than the building. The monuments of this period in the Holy Land may be considered as the cradle of the Romanesque school of Christian architecture; for though I speak of them as Byzantine, these buildings have not what we know architecturally as the Byzantine character of the Romanesque; they possess more of the character of the Roman Basilica, like many existing churches in Constantinople itself. There is at Gaza a church attributed to the Empress Eudoxia. I have not been there, but from the descriptions of it given to me by learned visitors, I believe it to be a work of that period. I may mention also the church of St. John the Baptist at Damascus, one of the most wonderful monuments of the kind. It is 400 feet long.

Four miles south-west from Jerusalem we have a most interesting ecclesiological monument (one of the earliest), a complete tesselated pavement. It is not of the kind we generally see in Romanesque churches, and of which we have a specimen in the sanctuary of Westminster Abbey, but it is made of square pieces of marble, and resembles the specimens found in the Roman baths rather than in churches. This pavement is in the church of the Holy Cross, on a spot which was of no importance before the Christian period; we must therefore recognize it as a Christian work, and the emblems introduced in it bear out that view. It follows the shape of the church, which is of the usual Basilican form, consisting of a nave, side aisles, transept and triple apse; in the middle of the transept, under the lantern, is a magnificent wheel of mosaic pattern, thirty feet in diameter, containing all kinds of early Christian emblems, the lotus, the peacock, the fish, &c. The rest of the pavement which covers the whole church, is simply of white tesseræ, or scored with thin lines of black dadi* in a lozenge pattern; the pavement of the nave has a border or frame of a guilloche pattern of several bands. This church is mentioned by Sæwulf, an English writer of the twelfth century, in an account of his pilgrimage, as not having been destroyed by the Saracens, while the surrounding buildings and the cells of the monks were laid waste. It is a plain church, having square piers and slightly pointed arches, the apses, as

* Dies.

usual in Palestine, being semicircular in plan, and slightly pointed in elevation. It is in fact a Transitional church, the pavement being of the Byzantine period, and the building about it of the school which we shall examine presently.

A better specimen of the Transitional style however, is the *Church of the Holy Sepulchre* itself, which we all connect with Jerusalem as its chief monument. In its present state, the Church is in arrangement what the Crusaders left it, but the details are not altogether of the time of the Crusades. If we examine the capitals, we see the patchwork it is made up of. In the gallery above the part known as the Arches of the Virgin, are two rows of pillars corresponding with each other. Those on one side consist of Byzantine shafts fitted more or less to Byzantine caps, but on the other side the pillars are rude imitations, executed in the eleventh century; being probably a restoration by Constantine Monomachus, and showing the period most obviously.

With regard to the primitive shape of the Church of the Holy Sepulchre, I differ from the conclusions of Professor Willis. He starts with the explanation of Eusebius, but has put forth very mistaken notions in his interpretation. He conjectures that the Emperor Constantine began by placing the Holy Sepulchre in an open court-yard behind the Basilica. Eusebius mentions the sacred cave, or Holy Sepulchre, as the head of the whole work; and he again uses the word in his description of the great apse, which must make us conclude that the sepulchre was the centre of that great apse, which he speaks of as being so much ornamented. That would show that Constantine built his church in the general form of the Roman Basilica; we should have the apse at the west-end, which was then the altar-end of the church; because in the Basilicas the priest had his face towards the people, and to the east. When Eusebius speaks of the Basilica being to the east of the sacred cave, he evidently can only mean the nave and aisles; since he speaks of the magnificent ceiling which Constantine placed over it, as covering the whole of the Basilica; but that could not cover the apse. If he used the word Basilica to mean the nave and aisles in speaking of the ceiling, he might use it in another part in the same sense. The present plan of the church leads us to that conclusion. We know that when buildings are restored, the old foundations are used again in erecting the new building; and the first glance at the plan of the Holy Sepulchre will give us the outline of the Basilican form. Professor Willis remarks that the Basilicas at Constantinople are described as dromical, that is to say, having the same outline that the Hippodrome had, a rectangle terminated at one end by a semicircle of the same width. After this church had been destroyed by Chosroes it was repaired by Modestus, whose means certainly were very limited, and he only rebuilt it in part, and covered over the Holy Sepulchre by completing the circle, one half of which was traced out already by the great apse. In fact the remaining part of the circle, which we know to be the present form of the nave of the church of the Holy Sepulchre, is only given by the piers of the central part, and in no way in the general outline or in the aisles.

The holy sanctuaries in this church are after all only three in number,—the Holy Sepulchre, the Calvary, and the Prison of our Lord. Now the church consisting of five naves, the Calvary would come exactly in the inner lateral nave on the south, and the Prison of our Lord in the outer lateral nave on the north. I make no allusion to the fourth sanctuary—that of St. Helena, which must have always been a church complete in itself. It has all the parts of a good old Basilica,—nave, aisles, three apses, &c.; the southern apse, on a lower level than the rest, being the spot where the cross was found.

Just at the entrance of the Ethiopian convent, over the subterranean church of St. Helena, I found an arch nearly complete of Byzantine character, which I believe must be attributed to

Constantine, and seems to have been one of the arches of the atrium in front of the Basilica. There is only just room for a good sized atrium between the arch and the remains of columns which still exist, and which have been identified by Dr. Schultz and others as parts of the propylæum of the atrium of Constantine's church of the Holy Sepulchre. There is only just space again between the arch and the Holy Sepulchre for a good Basilica; the Holy Sepulchre therefore was inside the church, and indeed the head of the whole work.

Having so far given you an explanation of the church as a Byzantine specimen of the architecture of the Holy Land, I will now refer to it as an example of the Crusaders' period. The Crusaders found it consisting of the round church of the Holy Sepulchre, properly so called, and a few scattered chapels, one covering Calvary, and another the Prison of our Lord. They proceeded to arrange the church after their own ecclesiological fashions, and reversed the sanctuary, placing it towards the east, where the nave of Constantine had stood, and constructing the choir according to the manner of the time, in which the priest turned his back to the people. They afterwards made a transept, the southern end of which is now the generally known façade of the church of the Holy Sepulchre, and used the round church as the nave of the newly arranged cathedral.

To begin the illustrations of the period, I submit a photograph of the present entrance to the church or the façade of the southern transept, and a more detailed one of the doorway, which displays evidently the true features of pointed architecture. This brings at once to our minds the vexed question of the origin of Gothic architecture. It is remarkable that we are now coming to a full series of pointed churches, all dating from the three first quarters of the twelfth century. They could not have been built later, since the Latins only occupied Jerusalem from 1099 to 1187.

I am the more convinced that our Western Gothic is derived from the Holy Land, because it is the only country which (at that very period when we all know that fashion grew up) had sufficient influence to introduce Gothic architecture in so many countries at once. The Holy Land was the scene of the "universal exhibition" of the twelfth century for Christendom; the point where all European nations met on common ground, and formed themselves into one common type, and one common nation. The great results of such a meeting are evident in scientific discoveries. The Assizes of Jerusalem are the first modern code of law in existence; and we may well conclude that in architecture also the Latins devised one common type for themselves. Mr. Thomas Hope, in his Historical Essay on Architecture, has very skilfully delineated the progress of almost every variety of style; but he seems to leave a *lacune* to be filled up between a Byzantine monument which he considers the first of that kind, the aqueduct of Justinian the Second in which pointed arches were used as a fashion, and the time when they were commonly used in the west. He conjectures that the Mahomedans took their pointed architecture from the Byzantines, and I agree with him. The Arabs made ample use of it several centuries before it was used in the west. There are several Arab monuments in Damascus and Cairo, which can be traced to the ninth and tenth centuries.

And to corroborate, as it were, my theory that it was in the Holy Land the Western nations became acquainted with the pointed arch, we see that wherever in other countries the same meeting took place between the Eastern and Western schools, the same effect was produced, namely, the engrafting of the details of the Romanesque schools upon Arabic architecture. We see that in Spain and in Sicily. In Spain there are two distinct styles of Gothic—the northern and the southern; the latter being indigenous, whilst the northern style was introduced from France. In Sicily, where the Normans met the Arabs, they formed the same amalgamation. This was in the century which preceded the twelfth. But we cannot, with Mr. Gally Knight, trace to Sicily the origin of such a simul-

taneous school spreading all over the West. Sicily never was a *fashionable* country; but the Holy Land has been, and it is the only one we can mention as a centre from which such a general fashion could spread all at once. There is, perhaps, one exception to the assertion that all the churches which the Crusaders built were in the pointed style; but that very exception confirms my views. It is the church commonly called the Church of the Knights of St. John, which is built in the Norman Romanesque style, displaying billet mouldings, and all the other details with which we are familiar. We must reflect that this building, though of *about* the time of the Crusades, must have been erected a little previous to them by the merchants of Amalfi, who founded the hospital, which became the birth place and head quarters of the order, about 40 years before the Crusades. The merchants came from a part of Italy which was then under the Norman sway. There are some instances of architecture similar to this church in the district of Amalfi itself, and it is no wonder that these people should erect in Jerusalem an isolated instance of their own noble style.

In studying the Jerusalem of the Crusades we are more fortunate than in our other archæological investigations, owing to the researches of a friend of mine, M. de Maslaterie, Professor of the Ecole des Chartes at Paris, who has brought to light a most valuable description of Jerusalem in a Norman Chronicle of the end of the twelfth century. This has been published by Comte Beugnot in his edition of the Assizes of Jerusalem; and nothing can be more interesting than being able to go about Jerusalem with this Chronicle in our hands, identifying almost every spot described in it. I am afraid if I were to follow it out in detail, I should extend my lecture to greater length than the time this evening permits.

The continuation of the subject, without abridgment, was adjourned to the next meeting.

ARCHÆOLOGICAL STUDIES IN JERUSALEM,

By G. J. Wigley, Associate.

Being Observations made at the Ordinary General Meeting of the Royal Institute of British Architects, March 10, 1856.

I do not know whether it is necessary to bring to the recollection of my hearers, that in dealing with the monuments of Jerusalem at the last meeting, I described those of the Jewish and the Byzantine periods, and I began to make some allusion to those of a more interesting class,—the Latin. I shall now endeavour to describe the character of such of the last named monuments as are still to be met with at Jerusalem.

We must necessarily begin with the Church of the Holy Sepulchre, and although Willis has so fully illustrated it, I may as well recall to your memory some portions of his description. In dealing with the Church of the Holy Sepulchre, so far as the Latin period of its history is concerned, we must remember that it was rebuilt towards the middle of the eleventh century by Constantine Monomachus, after its destruction by the orders of the Caliph Hakem. Afterwards, we have, first of all, the description of Sœwulf, an English pilgrim, in 1103, who gives us a description of the state in which the Crusaders found the church.

Referring to the plan, we can easily ascertain what portion of the church is of the time of Constantine Monomachus, namely, the round Church over the Holy Sepulchre, the Church of the Calvary, and the Chapel of St. Mary, all of which are mentioned by Sœwulf, as well as the Church of St. Helena; the transept and the choir being Latin additions. Entering the present church at the south transept, the present façade, and going to Mount Calvary on the right, we notice adjoining it a little chapel, with many Mediæval remains. The chapel is now cut off from the church, the doorway being walled up, and turned into a grated window; but it contains glass mosaics along the archivolt of the former doorway, which must be of the twelfth century. This chapel was the external porch of the Church of Calvary at that time.

Inside the little Church of the Calvary, in the southern aisle chapel, which still belongs to the Latins, is a very good specimen of the mosaic known as Alexandrine pavement, being quite different from that which I described at the last meeting as existing at the Convent of the Holy Cross. Some of the monks told me that the chapel is covered with mosaics, but that they are hidden under a thick coating of mortar. Under the summit of the vault, a mosaic figure of the Saviour is to be perceived with the help of a torch; but the whole of this part is exceedingly dark. Portions of Alexandrine pavement are to be found also in the enclosed aisle of the round nave of the Holy Sepulchre, and in the Grotto of Gethsemane.

The general arrangements of the church are Mediæval. The proportions of the central part of the transept or lantern are strictly Romanesque, being about a square and a half in height to the spring of the arches which support the lantern cupola; then comes on the plan a square chancel terminating in a semicircular apse with radiating arches, and an encircling aisle with three radial chapels.

Out of the northern transept is the Church of St. Mary, which has an outline of Mediæval design. Going from that northern transept westward, we come to the present round nave, in the encircling aisle of which are also three radial chapels, or apses. One of the most interesting remains in that part is the old font of the church, which is found on going out of the northern of these apses into a yard behind the church. Several fonts like this are to be seen in the Holy Land. In fact they seem to be, as in England, the oldest of the monuments in any church which still

exists. This font is mentioned by Willis as formerly being there, and I am happy to state that it still remains. It is octagonal inside, and square externally; each side of the octagon forming a semicircle, the plan is therefore like a rose. It is one of the ancient fonts used for baptism by immersion. There is one like this also in the basilica at Bethlehem, and I found one at Tecoa. The inside of these fonts was generally divided into two tiers; the uppermost being a hollow space of large diameter, and the lower one being narrower; so that there is a stone bench inside where a person might sit to be readily immersed by the priest. Close to this font in the yard there is a well which goes by the name of the well of St. Helena.

Two reservoirs on both sides of the church are alluded to by the Bordeaux pilgrim, A.D. 333, in his description of the Church of Constantine. The northern one still exists, and if not of Roman, is undoubtedly of Byzantine work; the southern one has disappeared. The same pilgrim mentions another at the back of the church to baptize infants, and this must be the well of St. Helena adjoining the old font.

I may allude to the Jewish tombs at the westernmost extremity of the church, just out of the western radial apse of the nave, and which seem to be fragments of a square funeral chamber cut diagonally by the foundations of the first church of the Holy Sepulchre. Dr. Schultz alludes to it, and remarks that it was not set exactly according to the cardinal points. Above this point, in the street outside, is the Latin western doorway of the church, which opened into the gallery or triforium of the round nave; for such is the difference between the street level outside westward and that of the church pavement, which was excavated round about the cavern of the Holy Sepulchre. This doorway (now walled up) is adorned with a shallow porch sustained on small columns and brackets.

Thus far I have alluded to the Church of the Holy Sepulchre as a Mediæval building, the Church of St. Helena belonging quite to the category of Byzantine churches, and having the usual divisions of those churches; and it is in reality quite apart from the general church, and at a much lower level.

On coming out of the Church of the Holy Sepulchre, we are induced to look about for the churches which must have surrounded it in the time of the Crusades, and we are amply repaid by keeping to the block of buildings of which it is the centre.

Immediately on coming out of the south transept, we have on the west of the entrance court buildings of the Mediæval period, being the three chapels, still in the position and use described by Sœwulf, as the parish church of the Greek Christians of Jerusalem.

In the southernmost chapel, the chapel of St. James, are some beautiful capitals of the form we usually see in the Mediæval architecture of the Holy Land, rude imitations of the Corinthian, with a considerable swell in the lower part of the capital; and there is some very good carving along the string courses and little arches of the chapel.

On coming out of the Church of the Holy Sepulchre we find, as mentioned above, a kind of court, surrounded on three sides by Mediæval buildings. At the southwest corner of this court is a whole column, and the bases of others which indicate that there must have been an arcade on the southern side, before the entrance to the Church of the Holy Sepulchre. This whole column, of which I have a photograph, appears to belong to the restoration of the church by Constantine Monomachus, and has a basket shaped capital.

We see in another photograph the Mediæval character of the southern transept, and what remains of the belfry of the church. Willis says it had formerly five stories, but at present there are only three.

Another photograph gives a general view of the Church of the Holy Sepulchre.

On the easternmost side of the court is a large Greek convent, occupying the site of the monastery of St. Mary the Latin. The lowermost story has three doors, as it is a building belonging to three

communions; the first door leads into the Greek convent of Abraham, as it is now called; another belongs to an Armenian Chapel, and the third (nearest to the Church of the Holy Sepulchre) is the door of the Church of the Copts. All that mass of building has a very Mediæval character, and we have a description of it both by Sœwulf and the Norman Chronicler, who state that there was a church and monastery existing there under the name of St. Mary the Latin. We can still trace in the western wall of the general mass of building towards the court the remains of the façade of the Church of St. Mary, containing a large recessed arch which has been filled up with masonry, and which is very much like the façade of the tomb of Our Lady. That design of façade is repeated in many works of the Crusaders. The capitals of the columns which supported this arch are still to be seen on the face of the present wall.

Going further eastward of that group of buildings which I have described, we have a large fragment of a building which seems to have a very ecclesiastical character, and which, on examining it very closely, I believe we may consider to be the refectory of the canons of the Church of the Holy Sepulchre, pointed out by the Norman Chronicle, which goes on to speak of their dormitories, and other buildings on the northern side of the church.

In the street that skirts that northern side, we have evidently very considerable remains of that convent, and especially a doorway.

At the north-west corner of that group of buildings we know there was the Palace of the Patriarchs (it was inhabited by the Greek patriarchs after the expulsion of the Latins), and the large doorway and entrance are still preserved and used as a mosque.

At the north-east extremity of the same block there is a very interesting building, which goes by the name of the House of the Prince; and I believe it to be the Palace of the Latin Kings of Jerusalem. It is rather puzzling to make that out; but we know from the various chroniclers of the time that King Baldwin and other kings of Jerusalem dispensed justice in the Temple of Solomon; and we know further, from my friend M. de Maslaterie, who discovered the Norman Chronicle, of a Deed of Gift from Baldwin of the lower part of his palace to the first Knights Templars. We know that afterwards the Knights Templars occupied the whole of these buildings; but we know nothing more of the residence of the kings of Jerusalem. Many have conjectured that they resided in the fortress, but this building at the north-east of the Holy Sepulchre presents a much more likely place for their palace. At the same time I cannot quote any further authority than the local tradition, the want of any other site, and the considerable remains of twelfth century architecture on the spot.

Opposite to the southern façade of the Holy Sepulchre Church, in another block of buildings, we have the remains of the great hospital of the Knights of St. John; indeed, the whole southern side of the Church of the Holy Sepulchre was skirted by their hospital. It was a very large establishment, contained 400 knights, and covered perhaps four or five acres of ground. The greater part, however, is now a kind of elevated grass close, but I believe we can penetrate underneath it to a considerable extent through vaulted arches, which keep up its artificial height, and are distinctly to be seen at the south-eastern extremity of that block of buildings, where the present corn market stands. Maundeville says, that within the palace of the sick men of that hospital there were 124 pillars of stone, and 54 pillars besides to support the house.

I mentioned at the last meeting the first church of that order, erected by the merchants of Amalfi, which we may identify with the Church of St. Mary the Great, that part of the hospital having subsequently been allotted to women. We have to confirm this the deed of King Almerie of Jerusalem, apportioning between the knights and the nuns of St. Mary a small street which separated their convents; and an architectural eye can distinguish where the wall was erected, which must have been between the two opposite corners of these buildings.

Next to that block of buildings are the three large streets of the Bazaar, which exists in the same state as in the time of the Crusades, and they terminate at the south with the Exchange, or Bourse of Jerusalem of that time, now a Turkish café, with large ancient columns and capitals.

Alluding to hospitals, I may mention the hospital of the Germans, very near the Bazaars, the birth-place of the order of the Teutonic knights, and which I have identified from its position in the ancient street of the Germans, and from its particular masonry, which is the same as that of the ruins of the palace of Frederick Barbarossa at Gelnhausen.

In addition to these, there was in the north-east quarter of the town a hospital dedicated to St. Mary Magdalene. During the Crusades that quarter was inhabited by the Latins almost exclusively, and was called the *Quartier de la Marie* or *Merie.*

In that part of the town there is also a number of ruined Mediæval churches. We can trace the remaining apses of the Church of St. Mary Magdalene, covered with faint traces of painting; the nave and aisles being now turned into a potter's workshop. There is also a small deserted church dedicated to the Nativity of the Blessed Virgin, the plan of which is a miniature model of that of the Mediæval churches of the Holy Land. It is only thirty feet square, and has a lantern, a transept, a chief apse, and narrow transept aisles, terminated by side niche-like apses, and in front an external narthex. The cupola over the lantern is pointed in elevation, and circular in plan.

Close to the eastern gate of the town is the large Church of St. Ann, now a Mosque, of which I have an external view showing the twelfth century Gothic of the Holy Land, which, you will perceive, displays much of the feeling of our own Pointed. It consists of a nave, aisles, a transept with cupola lantern, and three apses.

In the northern part of the town, and at the north of the Temple Close, is the locality of the Prætorium of Pilate, on which a Mediæval church has been erected. The sanctuary remains, with two side chapels. It is perfectly square, and turned towards the *south*, without any attempt at an eastern direction, or an apse. The place of the nave is now a court yard, where formerly no doubt was the atrium of the Prætorium. Protruding from the general square outline of the court is a little chapel, which is very remarkable. It occupies the traditional spot of the Coronation with Thorns, and consists of a little dome resting on four piers, a fair specimen of the votive chapels with which the Crusaders covered every holy spot. The whole building is comprised within the barracks near to the present governor's residence. Nearly opposite was a similar chapel covering the spot of the flagellation, but since the Franciscans have resumed possession, they have spoilt its Mediæval character by adding a nave in an inferior modern Italian style.

Another Mediæval church of St. Peter, in the north-east quarter, is now a mosque on the top of the hill Acra. In this church, the angles of the square piers between the naves are occupied by half engaged columns, and the string courses, which are of the simplest kind, consist of a plain fillet and deep chamfer divided by a small rebate. All these churches are not so curious for ornament and detail as for the suitable and ecclesiological character which they bear. They consist generally of a nave and two aisles, and a transept from which protrude directly three apses, semicircular in plan, and covered with a plain concha pointed in elevation, that is to say, produced by half the revolution of a pointed arch, springing from a string course cornice. All the piers are square, and support pointed arches of a low pitch, with square soffits. They are vaulted with plain pointed groining, without any other attempt at ribs than plain transversal arches to each bay.

Towards the north-west corner of the town are some ruins of a large tower known as the Tower of Tancred, which existed at the time of the siege of the town by the first Crusaders. This was the part attacked by that warrior and the English Crusaders, while Godfrey of Bouillon entered the

town through the north-east corner, which at that time was finished with a cant, and was the weakest part. The fortifications were afterwards altered, in that part, at the general restoration of the walls by the Turkish Sultan Sulciman, in 1542.

In the southern part of Jerusalem we find many Mediæval churches, particularly the large Church of St. James the Great, belonging to the Armenians; the Church of the House of Hannah, and some small churches having merely a nave and a little apse; such as the deserted church of St. James the less, behind the Protestant Church; the Church of St. Thomas, now a charcoal store; the Syrian Church of the House of John Mark, and the Church of the House of Caiphas outside the walls. Any description of these would be only a repetition, I therefore content myself with enumerating them. Many other churches are mentioned by the Norman Chronicle descriptive of Jerusalem in the twelfth century, and remains of them still exist. Outside the former town, on the east, there is the church of the tomb of Our Lady in the valley of Jehosaphat, at Gethsemane. It has an eastern and a western apse, and goes far under ground; a mere shell of rock, in the centre of the eastern apse, contains a funeral chamber which is supposed to have been the tomb of Our Lady, the surrounding mass having been cleared off, as for the tomb of Our Lord. On Mount Olivet the Church of the Creed, alluded to by Mediæval writers, is now a complete wreck; and it is a specimen of the way in which these monuments disappear. I found when I first went to Jerusalem twelve of the side arches existing; but I have seen it all excavated by the Turks to furnish tomb stones for the Jews. Of the Church of the Ascension there remains but the outline of its octagonal plan with two or three pier bases.

The last building I will allude to is, the little Church of the Cœnaculum. Here is a general view of the group of buildings which surrounds it. It is now held by the Mahomedans as the mosque of the tomb of David. It is nothing else than a Gothic church of the beginning of the fourteenth century, probably erected by the Franciscans, when they first came to the Holy Land. It has two naves, divided by round pillars, with ribbed and groined vaulting. What interested me most, was a dog-tooth moulding in the jambs of its windows. There is also a great deal of fourteenth-century carving, particularly vine garlands, along the string courses.

With regard to the dog-tooth ornament, I believe I may assign its origin altogether to the Holy Land, as well as that of the ball flower, which is repeated so commonly in Gothic buildings. The most common flowers in the Holy Land are the cyclamen or gazelle's horn, and the red anemone to which our Lord alluded when he spoke of the beauty of the *lily*, as it is translated. The former is evidently the type of the dog-tooth, and the latter of the ball flower.

Before concluding, I may say a few words upon the remaining Mediæval monuments in the Holy Land, which do not belong so strictly to the Archæology of Jerusalem. It is useful however, to appreciate it, to consider well also the monuments of the thirteenth century, erected in places occupied by the Crusaders, after they were driven from Jerusalem in 1187, when the capital of the Latins was removed to St. John of Acre.

Richard Cœur de Lion came as near Jerusalem as Ramleh, and nearly the whole of Galilee was in the possession of the Crusaders during the 13th century. We have in many of those parts,—at Samaria, at Tiberias, at Cana, at Sephoris, and at Athlit (known as the castle of the pilgrims), Gothic remains of the thirteenth century, with rib vaulting in great profusion, and at the latter spot particularly we see a large ruin, very little alluded to by travellers.

At Athlit, pointed arches are placed upon early Roman masonry, and we have even round Roman arches cut into pointed ones. There is a church, one side of which consists of a Roman wall with square windows, and the rest of the church is finished with rib vaulting, and the ribbing is even disposed into the form of an apse. There are also the ruins of a large polygonal apse, alluded to by Williams in

his Ecclesiology of Palestine, in the midst of Roman walls. This we may suppose to have been the site of the old citadel of the Templars, known also as the Castle of the Son of God; and most probably the true site of the ancient town of Dora. Just outside of Ramleh, we have extensive remains of a monastery attributed to the Knights Templars, with a large tall tower still standing. In the town itself, is a large Mediæval church formerly dedicated to St. Joseph of Arimathea; it is now a mosque, which I entered and leisurely examined, but from which I was at last expelled.

The Church of St. George at Lydda is referred to also by Mr. Williams in his articles on the Ecclesiology of Palestine, published in the Ecclesiologist in 1846-47. Local tradition ascribes this church to Richard Cœur de Lion. The large eastern apse and several piers still remain, and more may be traced along the former outline of the church.

With this I must conclude my remarks on the Mediæval architecture of Jerusalem. Of the present day there is very little ecclesiastical architecture to admire. The Easterns have no taste, and their churches are filled with lamps and ostrich eggs. But there is one point I may allude to as deserving attention in modern Eastern Ecclesiology; namely, the wood carvings, which are beautiful and skilful specimens of perforated work, having much of an early Romanesque character. Jerusalem is filled with the effects of the skill and industry of workmen in this branch of carving, who are still to be found in the Greek Archipelago.

I have to thank you for the kind attention you have paid to me; I have endeavoured to make myself as clear as possible, though I am rather unaccustomed to an English audience; and I shall be happy to stand catechising, if necessary, to endeavour to make myself better understood.

Mr. Scoles, Hon. Sec., inquired whether Mr. Wigley distinctly ascribed the Tombs of Jehosaphat and Absolom to the Jewish period, and to what particular era.

Mr. Wigley believed those monuments were decidedly of Jewish origin, from the plain Egyptian-like cornice which he had described. It was very difficult to decide their precise age, and he would therefore only say they were anterior to the time of Herod. Their mere weather-beaten appearance in such a climate, shewed that they must be very ancient.

Mr. Scoles said, that he had supposed these tombs to be of about the time of Herod.

Mr. Wigley. Herod had probably restored the work, but the Egyptian-like cornice clearly indicated an earlier date. There was a small monolithic tomb in Siloam, untouched by Herodian architecture, very similar to those of Zachariah and Absolom; and in the Tomb of Zachariah, the work of Herodian transformation seemed to be suspended in the midst of its operation in a most striking manner. As for real Jewish masonry in the walls of Mount Moriah, &c., there were two distinct kinds of masonry—rebated, and non-rebated. The former was generally described by travellers as formed of bevilled stones, representing the rebate as a chamfer, which conveyed an erroneous idea. In the Temple Close, the masonry of the southern, and of the eastern or golden gate, was entirely in one plane, without any rebate, and was quite distinct from the Byzantine or any subsequent masonry. He believed that the greater part of the Temple Close was much older than the time of Herod, and particularly the part called the Place of Wailing.

Mr. Nelson, Hon. Sec. It was stated that Herod rebuilt the whole of the Temple; and that subsequently there was not one stone left upon another.

Mr. Wigley. The Temple proper, or inner enclosure, was completely destroyed, and that by the most careful of destroyers, namely, a would-be *restorer*, Julian the Apostate; but the walls of the Temple Close had always existed. There was no kind of rustication about these walls; the joints were only rebated. The Roman masonry near the Close (as in the Town Hall *(Mekemeh)* and the entrance to

the old Cotton Bazaar, erected on the traditionary spot of the beautiful Gate) *was* rusticated, the stones being on an average three feet high; and the Samaritan Temple on Mount Gerizim displayed what might be Greek or Roman masonry, being rough Rustic work of the kind termed Pelasgic.

Mr. Scoles. Did Mr. Wigley suppose that the Crusaders introduced the pointed arch into Europe?

Mr. Wigley. Certainly. The gradual amalgamation of the Romanesque details with the main features of the Arabic style could be clearly traced in Jerusalem. The first Crusaders were not masons, but military men, and they rebuilt the monuments which were destroyed, employing the artizans of the country, and giving them the best notions they could. There were also ecclesiastics following the army, but these were rather military chaplains, and not so educated in ecclesiastical architecture as the regular orders were at that time.

Mr. Nash, Associate, inquired what kind of roofs covered the churches at Jerusalem?

Mr. Wigley stated, that the churches of the Holy Land were generally covered with vaulting. Even the best modern houses were covered with vaults and cupolas cemented over, and the only wooden roofs were those of the Mosque El Aksa, the Basilica at Bethlehem, the large dome of the Holy Sepulchre, and of the Mosque of Omar. Timber being expensive and stone plentiful, might account for this; and the climate did not render any effectual system of roofing necessary. The timber roofs were covered with lead; the Protestant Church of Jerusalem was at first covered with slate, but lead had since been substituted. In the stone cupola of the little church of St. Ann, the joints of the masonry (as shewn in the photograph) were distinctly visible, but generally all the cupolas were covered with cement.

Mr. Papworth, Fellow, suggested that the profile of the cornice which Mr. Wigley had characterized as Egyptian, was in fact Ionian; and appealed to Mr. Fergusson in corroboration of this opinion.

Mr. Fergusson, Associate, stated that the cornice in question was undoubtedly of Assyrian origin. At Khorsabad and Kouyunjik, three or four cornices had been found with the same profile, combined with the Ionic order. The bevilled masonry was also Assyrian, and the same affectation of large stones was remarkable in both countries. With regard to the age of the works referred to, he did not think it could be anterior to the time of Herod. The Jew's Wailing Place, he had little doubt, was also of the time of Herod; because the Bridge, which, as no one doubted, belonged to that era, was so mixed up with the other masonry, that it must have been of the same age. In a gateway mentioned by Josephus, of which Mr Wigley had submitted a photograph, the ornaments were the only specimens of decoration of Jewish character which he (Mr. Fergusson) knew of about Jerusalem. They were neither Corinthian nor Roman, but quite peculiar, and were dovetailed into the south wall, which was of the same construction all across; therefore there was very little doubt that that part of the wall was of the time of Herod. [Mr. Fergusson here sketched a plan of the Temple area, and proceeded to explain its topography.] The south wall of the Temple enclosure was 927 feet in length, and at the distance of 600 feet from the S. Wangle, a wall ran at right angles to it, completely confirming the assertion of Josephus that the Temple was 600 feet square. Beyond this this area was the series of vaults referred to by Mr. Wigley, and described by Professor Willis. The only document which Professor Willis had to reason upon, was a drawing by Mr. Catherwood. The pillars supporting the vaults were only 3 ft. 6 in. in one direction, and 3 ft. in the other, and they supported very weak arches; whereas, Josephus stated, that the pillars of the portico were so large, that three men spanning them round could scarcely make their fingers touch. It was therefore impossible that any such pillars could rest upon a pier below only 3 feet in diameter. Moreover, these pillars were disposed very irregularly, being some 15, some 20, some 30 feet apart, so that it was impossible

for the pillars of the great stoa basilica of 40 or 50 feet high to have rested upon them. He felt no doubt, that the limit of the Temple was therefore the 600 feet marked by the eastern wall.

There were also three arches of very inferior and weak masonry [referring to sketch] of the Byzantine period; or if they were not of that period, they must have been added afterwards. He believed that these arches, with the vaults before referred to, were built to make a foundation for the Church of St. Mary, erected by Justinian. At one angle of the Temple, as thus circumscribed, there was one stone with Jewish mouldings. It was a single stone, connected with nothing, and leading to nothing. All these circumstances tended to prove that the Temple stood on the spot referred to, and that the 600 feet, which the wall shewn in the sketch circumscribed, was the limit of that Temple. Mr. Wigley had called the Golden Gate, Herodian, but the pilasters outside were debased Corinthian. So far as he (Mr. Fergusson) knew, there was no instance of a bent entablature before the age of Constantine; bent architraves there were, but not frieze and cornice. The first instance was to be found in the Palace of Diocletian at Spalatro. The Golden Gate was of the age of Constantine, and was built as part of the basilica which he erected in front of the Holy Sepulchre.

Mr. Wigley. The same scroll ornament or garland was found on the bent *architrave* or frieze of the southern gateway of the Temple Close, and on that of the Golden Gate, which was not properly an entablature.

Mr. Fergusson observed, that Mr. Wigley's photographs contradicted this. He made a stand upon the point, that these pilasters were debased Corinthian, and that no instance of a bent entablature could be referred to of earlier date; whereas afterwards, bent entablatures were the rule, and thousands could be referred to.

Mr. Scoles said, that he had a strong impression that the work was of the time of Herod.

Mr. Fergusson proceeded to mention the Mosque El Aksa, which was known to be the Temple of Solomon down to the time of Benjamin of Tudela. It was absolutely certain that Justinian did not build his church on the site of the Temple of Solomon, because Julian the Apostate attempted to rebuild the temple there, and it was considered during the whole middle ages an accursed spot. No apse could ever have existed there. The dome of the mosque and the niche of the mirhab were parts of the original structure. Therefore, there never could have been an apse there; and there was not a single Christian Church built by Justinian without an apse.

Mr. Wigley. In Jerusalem, to suit localities, many ecclesiastical rules were departed from. The same rule of the apse might be applied to the 12th century, yet many of the churches of the Crusaders had no apse. In the Prætorium of Pilate there was plenty of room to build an apse, but to keep to the general outline of the foundations, they finished the church with the genuine English fashioned flat end, and turned it to the South.

Mr. Fergusson. The Mediæval historians mentioned the coming of the Mahomedans, and described the appearance of the Temple, so as to leave no doubt but that they knew perfectly well then where the Temple stood, and what were its boundaries.

Mr. Wigley. The Mediæval expression, Temple of Solomon, was given to the spot where Solomon gave justice, and where his palace stood; but every one of the writers who called El Aksa the Temple of Solomon, made allusion to the Mosque of Omar as the Temple of our Lord.

[Mr. Fergusson and Mr. Wigley here discussed the topography of the Temple further in detail.]

Mr. Fergusson then referred to a statement of Dr. Barclay, an American missionary at Jerusalem, with regard to the water in the large tanks of the Temple at Jerusalem, and their communication with the pool of Siloam, which he conceived to be a strong confirmation of his views of the site of the Sepulchre.

Mr. Wigley stated, that there was a tunnel under the hill of Ophel at the foot of Moriah, through which he had passed, extending 1800 feet underground, and bringing the water of the fountain of Siloam into the pool of Siloam, but he knew of no communication between that and the Temple cisterns.

Mr. Fergusson observed, that this subterranean communication was noticed by Willibald,* who went to Jerusalem after the time of Justinian.

Mr. Papworth inquired in what the peculiarity existed which Mr. Fergusson stated to be the Jewish style.

Mr. Fergusson said, it was merely the scroll ornament or garland, which had a very Assyrian character.

Mr. Fowler, Fellow, suggested, that the word Temple was not sufficiently understood. It was sometimes applied to the main building or sanctuary, and sometimes to the whole of the sacred precincts; a difference which might account for some of the discrepancies as to the dimensions of the Temple.

Mr. Fergusson. The Temple resembled a mosque in having a large court yard, with a sanctuary in the centre. The Temple of Jerusalem was an enclosure of 600 feet square, with the Temple itself, or the sanctuary in the centre.

The Chairman (Mr. Penrose, V.P.) When the Jews went up into the Temple to pray, they did not go into the sanctuary itself.

To an inquiry whether the style of the Mahomedan buildings of the Holy Land resembled that of Constantinople, Mr. Wigley replied that the Mahomedan buildings of Jerusalem were quite plain. The convents of the Dervishes, on the western side of the area of the Mosque of Omar, were of a very plain kind, with occasional cupolas. The hospicium of the Hindoo Mahomedan pilgrims, close to the arch of the Ecce Homo, had very good and careful masonry, but nothing of an ornamental character. A large hospital of the fifteenth century, called the Hospital of St. Helena, in the same Mahomedan quarter, was a very fine building, consisting of alternate layers of variously coloured stone, the ordinary limestone of the country, a kind of imperfect red marble, known at Jerusalem as the marble of St. Cross, and a bituminous stone found in the neighbourhood of the Dead Sea.

To an inquiry whether the Mosque of Omar was a Mahomedan building, and of what date?

Mr. Wigley said, that the question was become one of theory of late, although all Mohammedan writers agreed in attributing it to the Calif Abdel Malik, in the seventh century. The appearance of the Mosque of Omar justified the idea that it was built in that century, when the Mahomedans were anything but skilful artists, and with Byzantine materials brought from other buildings. The name of the architect Abel mikdam Redja Hayvet, was mentioned by a Mahomedan author, Medjer-eddeen, who added, that he had red hair and a white beard.

Mr. Scoles inquired where Mr. Fergusson supposed the Church of the Sepulchre to have been?

Mr. Fergusson stated, that he placed it to the northward of Mount Moriah. He had, in fact, no doubt but that the building now called the Mosque of Omar was the identical Church built by Constantine over the Holy Sepulchre.

Mr. Wigley dissented from Mr. Fergusson's views, which appeared to him to limit Jerusalem to much too small a space.

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* It is Antoninus of Placentia, whom the Bollandists term an "*anile*" story-teller, who mentions an apple thrown in a well near the Holy Sepulchre coming out again at Siloam.—G. J. W.

Mr. Fergusson said, that far from doing so, he made it larger than the advocates of the present site of the Holy Sepulchre, who drew the wall so as to get it outside. His impression was, that the second wall must go round so as to enclose the present Sepulchre in the city, otherwise the inhabitants could not have been 20,000 at any time.

Mr. Wigley observed, that he had merely endeavoured to illustrate the topography of Jerusalem as far as he was able. It had been discussed by much more able men than himself. Dr. Schultz had written a very learned and laborious work on the subject, and had traced the foundations of the second wall of Jerusalem, in a patient, and as he, Mr. Wigley thought, a masonic manner; indeed, there was as good an authority for the position of that wall, as for any point in architectural archæology.

Mr. Fergusson said, that he could not identify so many of the traces of the second wall which Dr. Schultz pointed out.

In reply to Mr. Papworth, as to the site of Golgotha, "the place of the skull," Mr. Scoles, Mr. Fergusson, and Mr. Wigley, explained its identity with Calvary, and that it was supposed to be included in the modern Church of the Holy Sepulchre.

Mr. Wigley observed, that the length of time occupied in the building of the city, would account for many irregularities in the first plan. It was first built as a military town, and occupied the site of Mount Zion, but when the ecclesiastical town was added by Solomon, it occupied also the site of Mount Moriah. Afterwards, the Emperor Adrian, who might be considered the designer of the present configuration of Jerusalem, and who was himself an architect, built the town all at once, and therefore chose naturally the outline which would include the most space with the smallest amount of fortification, and adopted a regular square plan.

Mr. Scoles. It was distinctly stated, that Adrian took in parts that were not enclosed before, and left out parts that were enclosed before.

Mr. Fergusson inquired by what author this was stated?

Mr. Papworth observed, with reference to the peculiarities in the masonry at different epochs, that M. Viollet-le-Duc (s. v. Brettoir) had made a similar observation to that of Mr. Wigley, in reference to Mediæval masonry; a great and distinct difference of tooling being perceptible in the different centuries. The faces were plain until the middle of the twelfth century—from 1150 to 1250 they were roughly indented, less so from 1300 to 1400, and they became again plain in the sixteenth century. With regard to the origin of the pointed arch, he had been informed that there was a little church at Ani, in Armenia, supposed to be of the date of 1010, in which both round and pointed arches were used, in such a manner, that the latter could not have been inserted at a later period. He had also heard, that the Armenians had always been the chief builders for the Turks throughout Asia Minor, and even Egypt.

Mr. Scoles stated, that Armenians were employed in the East for all building and handicraft purposes, to the exclusion of all others except the Maltese, who were known as the Scotchmen of the Mediterranean.

Mr. Wigley added, that whilst the Armenians were the best handicraftsmen, the Greeks were the best wood carvers and painters.

Mr. Papworth moved, and Mr. Scoles seconded, a vote of thanks to Mr. Wigley, which was carried unanimously.

Mr. Wigley, in acknowledging the vote, ascribed the success, which had attended his investigations, to his previous studies of the subject as a pupil under Mr. Scoles.

The meeting then adjourned.

ADDENDA.

I.—I have lately ascertained by enquiry at the British Museum, that the bunch of grapes, which was the central ornament of the frieze over the entrance of the Tombs of the Kings, described in page 96, is the special emblem found on the reverse of almost every coin of Herod the Great.—G. J. W.

II.—*The following Table of Architectural Dates in the History of Jerusalem is given to assist the Archæological Student.*

	BEFORE CHRIST.
City of Sion taken by David	1049
The Temple Built by Solomon	1012-05
Second Wall of Lower City begun by Hezekiah	713
Destruction of the Temple and City by the Chaldeans under Nebuchodnozzor	587
Rebuilding of the Temple by Zorobbabel	535-15
Rebuilding of the City Walls by Nehemiah	445
Rebuilding and Enlargement of the Temple by Herod the Great	30
	AFTER CHRIST.
Third Wall of the New City by Herod Agrippa I.	42
Destruction of the Temple and City by Titus	70
Rebuilding of the City by the Emperor Adrian as Ælia Capitolina, Adrian and Aquilla Architects	136
Building of the Church of the Holy Sepulchre under Constantine the Great	326-36
Completion of the Destruction of the Temple proper under Julian the Apostate, Alypius, Architect	362
Building of the Church of St. Mary under Justinian, Theodore, Architect	532
Destruction of the Church of the Holy Sepulchre by the Persians under Chosroes	614
Rebuilding of the Church by the Patriarch Modestus	615
Jerusalem taken by the Saracens under the Calif Omar	634
Building of Mosque of Omar by the Calif Abd-el-Melik, Abelmikdam Reja Hayvet, Architect	688
Destruction of the Church of the Holy Sepulchre by the Calif Hakem	1010
Rebuilding of the Church by the Emperor Constantine Monomachus	1048
Jerusalem taken by the Crusaders	1099
Jerusalem re-taken by the Saracens under Salaheddeen	1187
Ptolemaïs, or St. John of Acre, taken from the Latins by the Saracens under Ashraf Khalil	1291
Jerusalem taken by Selim I. Othoman Sultan	1517
Rebuilding the Walls of the City by Suleiman I.	1542-3
Fire in the Church of the Holy Sepulchre	1808
Restoration of the Church by the Greek Clergy, Commenes, of Mitylene, Architect	1810

The cost of the Restoration amounted to £640,000.; that is to say, £160,000. for the building, and £480,000. to satisfy the cupidity of the Turkish authorities.

III.—From the description given above of the pointed churches of the Holy Land, many will recognise a family likeness between them and the Cathedral at Monreale, and several smaller churches in Sicily, and in the south of Italy. In fact, they all belong to the same style—the earliest Gothic of all, the early Eastern of the twelfth century—a school of architecture hitherto entirely overlooked.

There are also in the East specimens of *rib-groined* churches (as that at Athlit of Galilee, and of the Cænaculum, mentioned in the Lecture), but they are all of the thirteenth century, and belong to the Gothic style re-imported from the West, after its Eastern models had been studied and developed, chiefly by the German freemasons.

Nothing could be more interesting for our art than a complete study of the monuments erected by the Latins, in the several states which they founded in the East, from the eleventh century till the conquest of Cyprus by the Turks in the sixteenth century.—G. J. W.

ON THE TRIUMPHAL ARCHES OF THE ROMANS.

By T. L. Donaldson, Hon. Sec. Foreign Correspondence.

Read at the Ordinary General Meeting of the Royal Institute of British Architects, March 31, 1856.

The Earl de Grey, K.G., President in the Chair.

Having been invited by my colleagues, the honorary Secretaries, to bring before the attention of the Members this evening some topic connected with our art, I felt that, however unworthy to address this assembly on such an occasion, I could not resist the application.

On thinking over various subjects which presented themselves, it occurred to me, that Triumphal Arches form a class of monument rarely receiving the attention it deserves, and that there is much to learn and consider as to their origin, destination, and appropriateness, when considered as works of art. And that perhaps the subject is not altogether inapt on the present occasion,* when a professional brother receives from the hands of your lordship, as the organ of the Sovereign and his fellow-labourers in art, the highest distinction that can crown a life of earnest and zealous cultivation of a pursuit, which it is the object of this Institution to promote. He has this evening come to receive the honours of an ovation, of a triumph, the congratulations of his compeers, a brilliant and lasting testimonial, which must gild his future years. And although an arch of stone, of marble or of bronze be not erected, as they were of old to record the bloody victories of the Roman warrior, yet he is enabled to say with the poet—

"Exegi monumentum ære perennius."

Before we proceed to examine the varieties and decorations of the triumphal arches, presented to observation in the illustrations, it will assist our full appreciation of their arrangement and embellishments, if we are acquainted with all the particulars of the processions, which the arches were intended to embody and commemorate.

Triumphal processions were of very early origin, and although writers are not agreed as to the precise Conqueror, by whom they were instituted, yet most appear to consider that Romulus was the first, who thus celebrated his victory over King Acron, whom he slew, and whose armour he deposited in the Temple of Feretrian Jove in the Capitol, being the first to dedicate such trophies as "spolia opima." From his time to that of Vespasian and Titus there were no less than 130 triumphs; yet so jealous had the Romans been, lest these ceremonies should be too easily decreed, that it was a law, that no triumph should be allowed unless 5000 of the enemy had been slain in one battle, and this was required to be verified on oath by the General.

The Conqueror having written to demand of the Senate a triumph for himself and army, the proposition was scrupulously examined, to ascertain if any objections existed to granting it, and none could receive the distinction unless he were Dictator, Consul or Prætor. These triumphs might be of two kinds: the principal one, when the Imperator passed in procession in a chariot through the city; or an ovation when he triumphed only on foot or on horseback, or with his troops proceeded to the Temple of Jupiter Latialis, on the Alban mount, a few miles from Rome. In the meantime the General with his cohorts awaited the decision of the Senate outside the Porta Capena, and in the plain under the Janiculum hill, between the Vatican and the present Castle of S. Angelo. As soon as the permission was conceded, sacrifices were offered to Mars, Juno and Jupiter, by himself, if he had

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* The Presentation of the Royal Medal to W. Tite, Esq., V.P., M.P.

the dignity of the pontificate; if not, by the Pontifex Maximus. He then robed himself in his triumphal habit, assumed the laurel crown, and with the palm branch in his hand, distributed honours and rewards to his brave companions in arms. To some he gave collars or rings, to others consecrated spears, and money, and ornaments; to these golden crowns, to those silver ones. If any had first mounted the enemies walls, he had the mural crown. If he had seized a castle, the castellated one. If he had distinguished himself on board the vessels, a rostral crown; or had he performed any brilliant feat as a cavalry soldier, the equestrian crown. Each had his appropriate reward; and bucklers, cuirasses, helmets, shields, swords, or greaves, sumptuously carved by the most eminent artists, or most elaborately decorated, were profusely given—not only to individuals, but to cohorts and legions, as standards or portions of the spoils taken in the war. Nor were the people forgotten. To propitiate their good will abundant largesses were distributed profusely right and left.

All the Temples were thrown open, and the several porticoes, theatres, fora, and other public buildings were hung with festoons and all sorts of ornaments; the houses and palaces on every side were decorated with hangings and tapestries, and everything that could contribute to the splendour of the festival, which was that of the people, as much as of the General and his army, and a source of joy to every rank and grade.

The procession, passing through the triumphal gate, was met by the Senate and accompanied by that august body over the triumphal bridge along the triumphal way, passed the Circus Agonalis, the Theatre of Pompey, the Circus Flaminius, the Portico of Octavia, the Theatre of Marcellus, the Circus Maximus, after which it fell into the Via Appia, under the arches into the Via Sacra, along which it proceeded through the Forum Romanum, and then ascended the Capitol to the Temple of Jupiter. This circuitous route was no doubt adopted in order to afford to all the opportunity of witnessing the magnificent cortege, and allow of a greater display of the objects, which swelled the lengthened procession.

The Conqueror rode in a chariot, which was round in the form of a castle, and in the earlier periods was drawn by white horses. Pompey or Camillus was the first to substitute elephants.* Eliogabalus introduced tigers and lions, to imitate the triumphs of Bacchus and Mars; and Aurelian was drawn by stags.

If the General had children, they sometimes were with him in his chariot, or if he had several grown up they accompanied him on horseback. Appius Claudius had his sister Claudia, the vestal virgin, with him, when he triumphed.

The description given by Plutarch of the triumph of Paulus Æmilius is so graphic and minute, and illustrates so fully the actual circumstances of this pomp, that we shall now adopt his words in order to convey an adequate idea of the splendour of that festival, which exceeded any, that had hitherto been given, and does not seem to have been surpassed in after times. "The triumph is said to have been ordered after this manner. In every theatre, or as they call it, circus, where equestrian games used to be held, in the forum, and other parts of the city, which were convenient for seeing the procession, the people erected scaffolds, and on the day of the triumph were all dressed in white. The Temples were set open adorned with garlands, and smoking with incense. Many lictors and other officers compelled the crowd to make way, and opened a clear passage. The triumph took up three days. On the first, which was scarcely sufficient for the show, were exhibited the images, paintings, and

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* A medal of Domitian shews a Triumphal Arch surmounted by *two* chariots back to back, each drawn by four elephants, and each containing the Emperor; alluded to in the 62 ep. of Martial.

"Hic gemini currus numerant elephanta frequentem."

colossal statues, taken from the enemy, and now carried in 250 chariots. Next day, the richest and most beautiful of the Macedonian arms were brought up in a great number of waggons. These glittered with new furbished brass and polished steel, and though they were piled with art and judgment yet seemed to be thrown together promiscuously; helmets being placed upon shields, breastplates upon greaves, Cretan targets, Thracian bucklers, and quivers of arrows huddled among the horse's bits; with the points of naked swords and long pikes appearing through on every side. All these arms were tied together with such a just liberty, that room was left for them to clatter as they were drawn along; and the clank of them was so harsh and terrible, that they were not seen without dread, though among the spoils of the conquered. After the carriages, loaded with arms, walked 3000 men, who carried the silver money in 750 vessels, each of which contained three talents, and was borne by four men. Others brought bowls, horns, goblets, and cups, all of silver, disposed in such order, as would make the best show, and valuable not only for their size, but for the depth of the basso relievo. On the third day, early in the morning, first came up the trumpets, not with such airs as are used in a procession of solemn entry, but with such as the Romans sound when they animate their troops to the charge. These were followed by 120 fat oxen, with their horns gilded, and set off with ribbons and garlands. The young men, who led these victims, were girded with belts of curious workmanship; and after them came the boys, who carried the gold and silver vessels for the sacrifice. Next went the persons with the gold coin in vessels, which held three talents each, like those that contained the silver, and which were to the number of 77. Then followed those, that bore the consecrated bowl of ten talents weight, which Æmilius had caused to be made of gold, and adorned with precious stones; and those, that exposed to view the cups of Antigonus of Seleucus, and such as were of the make of the famed artist, Shericles, together with the gold plate that had been used at Perseus's table. Immediately after, was to be seen the chariot of that prince, with his armour upon it and his diadem upon that; at a little distance his children were led captive, attended by a great number of governors, masters, and preceptors, all in tears, who stretched out their hands by way of supplication to the spectators, and taught the children to do the same. There were two sons and one daughter, all so young that they were not much affected with the greatness of their misfortunes. This insensibility of theirs made the change of their condition more pitiable, insomuch that Perseus passed on almost without notice, so fixed were the eyes of the Romans upon the children from pity of their fate, that many of them shed tears, and none tasted the joy of the triumph without a mixture of pain, till they were gone by. Behind the children and their train walked Perseus himself, clad all in black, and wearing sandals of the fashion of his country. He had the appearance of a man that was overwhelmed with terror, and whose reason was almost staggered with the weight of his misfortunes. He was followed by a great number of friends and favourites, whose countenances were oppressed with sorrow, and who, by fixing their weeping eyes continually upon their prince, testified to the spectators, that it was his lot which they lamented, and that they were regardless of their own. He had sent to Æmilius, to desire that he might be excused from being led in triumph, and being made a public spectacle. But Æmilius, despising his cowardice and attachment to life, by way of derision it seems, sent by word, 'That it had been in his power to prevent it, and still was if he were so disposed,' hinting, that he should prefer death to disgrace. But he had not the courage to strike the blow, and the vigour of his mind being destroyed by vain hopes, he became a part of his own spoils. Next were carried four hundred coronets of gold, which the cities had sent to Æmilius, along with their embassies as compliments on his victory. Then came the Consul himself, riding in a magnificent chariot; a man, exclusive of the pomp of power, worthy to be seen and admired; but his good mien was now set off with a purple robe interwoven with gold, and he held a branch of laurel in his right hand. The whole army likewise

carried boughs of laurel, and divided into bands and companies, followed the General's chariot; some singing satirical songs usual on such occasions, and some chanting odes of victory, and the glorious exploits of Æmilius, who was revered and admired by all, and whom no good man could envy." —(Langhorne).

It seems to be admitted that triumphal arches are of Roman origin; for we have no instance of such edifices in Greece before the Roman dominion. It may be presumed, that they may have first derived their form from the temporary erections of a rustic character, which may have been constructed to greet the conquerors as they approached the capital; or possibly were merely a more ambitious development of the rude city gates which were probably decorated temporarily, and called "arcus subitanei" for the occasions when the army returned after a victory. Fabrizzi, in his "*Roma*," enlarges upon the subject, and considers that probably the arch of Romulus was of brick. Even now some are of stone, as that of Gallienus at Rome; but of course the most important are of marble, as those of Septimius Severus, and Constantine. Some presented only one opening, with an attached column at each outer angle, as that at Susa and the one at Aosta. An example of a central archway flanked on each side by two columns is frequent, as in the arch of Titus, at Rome, and in that at Pola in Istria; others had two openings of like size, which also served, like the Porta S. Maria Maggiore at Rome, as city gates, and this arrangement was peculiarly adapted for the purpose to prevent confusion in those entering or going from the city. Another class consisted of three archways, a central or larger one, and two smaller side ones, as in the arches of Septimius Severus and Constantine at Rome. That city was not the only one, which had triumphal arches in the centre of the city; for at Palmyra and Antiocheia there is one in the middle of the grand colonnade or avenue, which traverses the centre of these towns. Fourteen arches are enumerated by topographers as having been at Rome, from the description of historians and P. Victor. Of those which remain, the first erected to any emperor was that to Titus. They were however frequent wherever the Roman rule prevailed, for we find them in every province, in Western Spain, along the coast of Africa, to the South in Egypt, to the East in Syria, and Northward in Gaul. They also formed important features in many public edifices, as in the Circi, each of which had two or three, and in the fora also as at Pompeii. The via triumphalis and via sacra at Rome had a succession of them.

The Romans seem to have used the utmost license in regard to the decorations of these monuments, which, as being objects of show rather than of use, might admit of some caprice, and not be bound down to the severe canons of the art. It would appear that the composite order owed its origin to them, as affording greater opportunity for the accumulation of enrichment; but, although it is considered to be of a more elaborate and elegant character than the Corinthian, yet in truth it departs from the grace of the latter, and is heavier instead of being lighter in its proportions. The capital is obviously so, when we consider the heavy volutes of the Ionic being substituted for the caulicoli of the Corinthian. The pedestal under the columns is a peculiar feature of the triumphal arch, as also the attic above the entablature, which gives increased altitude to the mass, and tends to upraise the glorious groups of sculptures, which surmounted the whole as a crowning galaxy of splendour. Nor did the ancients consider themselves confined to any one order, for we find at Arsinoe in Egypt the Doric. This presents a tetrastyle frontispiece surmounted by a pediment, and having in front of the pilasters on each side superposed Corinthian columns and entablature of less size. In others the Corinthian or composite is indifferently adopted; but the most remarkable license occurs in the arch at Aosta, which has columns of the Corinthian order surmounted by a Doric entablature, a contrast, which recals the trite remark of Horace as being applicable to architects, "quidlibet audendi."

The sculptures which adorn them are remarkable and valuable, as they hand down to us many of the incidents of the wars, which they were intended to commemorate; or circumstances in the life of the Emperor, whose memory they were proposed to honour. The arch of Titus bears even now the full sized representation of the seven-branched candlestick and other trophies of the Jewish war. It also gives the apotheosis of the Emperor upborne to heaven on an eagle's wings. The sculptures, which crown the attic, must have been most profuse and sumptuous, consisting of the conqueror borne in his triumphal chariot, attended by Victories and his family on horseback, flanked by trophies and warriors, forming together a numerous retinue of attendants. These probably were most frequently of bronze, possibly gilt; and the whole surface presented an elaborate profusion of sculptured embellishments. The soffits of the arches were richly coffered, the panels were filled with continuous scrolls, the friezes with processions, the spandrils to the central arch were enriched with figures of Fame proclaiming the glories of the conqueror, and the very keystones themselves were emblematically carved with winged victories.

But it appears that they were also of marble, for Pliny, l. 36, c. 5, mentions the triumphal arch erected by Augustus to Octavius, surmounted by a chariot with four horses, on which the figures of Apollo and Diana were seated, all carved by Lysias out of one block of marble, and highly praised for its excellence and great artistic merit. In fact a triumphal arch without these full groups of figures would have been considered deficient in its chief purpose and decoration. The arch of Nero (on a coin) with its pendant festoon shows how these monuments were decorated on festive occasions.

It is remarkable that Vitruvius never alludes to triumphal arches. We may thence infer that few existed at his time, and these were not considered a special class of edifices, and had not the peculiar characteristics, particularly of the composite order, by which they were subsequently distinguished.

Consult also Bergier, Histoire des Grands Chemins de l'Empire Romain, 4to, Paris, 1628—Piranesi sopra gli Archi Sparsi in Italia—Panvinius (O.) Amplissimi Ornatissimi Triumphi, 4to. Antw. —Rossini Gli Archi Trionfali, onorarii e funebri degli antichi Romani, &c., fol. Roma, 1836.

TRIUMPHAL ARCHES.

In Rome.

Arcus Claudii Drusi,
„ Constantini,
„ Dolabellæ et Silani,
„ Domitiani,
„ Fabiani et Allobrox in Sacrâ Viâ,
„ Gallieni (Lapideus)
„ Gordiani,
„ Gratiani, Valentiniani et Theodosii,
„ Jani Quadrifrontis,
„ Marci Aurelii et Lucii Veri (in Corso),
Arcus Neronis in Capitolino Monte,
„ Octavii,
„ De' Pantani,
„ S. Laurentii,
„ S. Sebastiani aut Porta Capena,
„ Septimii Severi,
„ „ in Foro Boario,
„ Tiberii,
„ Titi.

In Italy.

Ancona, Benevento, Susa,
Aosta, Rimini, Verona (2).

In the Provinces.

Pola in Istria,	Antiocheia,	Antinoe, Egypt,
Athens (?),	Palmyra,	Africa (various).

France.

Arles,	Cavaillon,	Postumi,
Autun,	S. Chaumas (Pons),	S. Remy,
Carpentras,	Orange (Charii),	Reims.

N.B.—Where the proper ascriptions of the arches have been recognized, the original name is given, but in other cases, the usual modern name is preserved to insure the identity.

The PRESIDENT expressed to Mr. Donaldson the thanks of the meeting for his instructive and interesting communication.

The PRESIDENT, in presenting the medals and prizes for the year 1855, addressed each of the gentlemen to whom they had been awarded in terms of commendation and encouragement.

On Mr. TITE coming forward, amid much applause, to receive the Royal medal, the PRESIDENT said, he expressed his satisfaction last year, on presenting the Royal medal, at the fact of its being conferred upon a foreigner, as he felt that it was an indication of impartiality, and that nothing like favouritism had influenced the distribution of the Society's highest honour. Having thus expressed himself in favour of M. Hittorff last year, he had, with equal gratification, to express the great pleasure he experienced this year in having to present the Royal Medal to an Englishman. (Applause.) Mr. Tite was well, deservedly, and universally known to them. They had in one of the greatest works in the City of London a production of his genius and design, and he hoped they would have many others equally useful and important, if not so rich, so ornamental, and so elaborate; for it should be remembered, in the profession of architecture, there was no one thing more important than that a man should be a man of versatility, and able to deal with all the different subjects that came before him. A man might be an excellent architect for a great work, but he might fail in the design or execution of a minor one. He might be unequalled in the execution of a highly elaborate and ornamental work, but might fail in a simple and a small one. Mr. Tite, however, had not confined his genius exclusively to one of these, but had shown his capability and power in one no less than in the other; to use a homely simile, like the elephant with his proboscis, he could lift an oak, or take up a straw. The honoured recipient of the royal prize had exhibited in many instances not only his power of design and imagination, but his facility in dealing with and adjusting difficulties—of conciliating and adjusting differences of opinion, of bringing people to agree together who had previously been antagonistic—an accomplishment of rare possession and of immense importance. A man might have the greatest taste and the greatest ability in his profession, but yet be deficient in those qualifications, and so be prevented from being permanently and positively useful. When he (Earl de Grey) had the pleasure of collecting his friends round him last year, he regretted being deprived of the pleasure of Mr. Tite's company by the new engagement that gentleman had embarked in, which he hoped might conduce, not only to his own interest, but to that of the profession of which he had been so great an ornament. Since then, and consequent on Mr. Tite's efforts in his new sphere of Parliamentary usefulness, the profession, he believed, had been indebted to his efforts and weight and experience for

advantages which, perhaps, would not otherwise been obtained. (Applause.) He (Earl de Grey) believed that certain legislative provisions that had been lately passed were in a great degree attributable to the efforts made by Mr. Tite in the new position in which he had placed himself, and for which the whole profession and the community were truly grateful; and he only hoped that in all future time he might lay his fame and fortune on a sound and constitutional concrete—that his footing and foundation might be firm, and the superstructure such as might realise most completely his own expectations and the best wishes of all his friends. He (Earl de Grey), on the part of the Institute, and with the sanction of Her Majesty, had the utmost pleasure in presenting the Gold Medal. (Applause.)

Mr. Tite said it had been the custom of the Institute to permit the recipient of this, its greatest gift, to return thanks in a few words; but he would first say, he thought the Institute was deeply indebted to the Noble Earl for his kind condescension in attending on occasions like the present, and in so gracefully enabling the Society to record its wishes and feelings in regard to the recipients of its honours. For himself, he had to thank his Lordship emphatically for the very kind and gracious way and words in which he had been pleased to pay him such distinguished compliments. He also felt that he owed a debt of heartfelt thanks to those of his compatriots in the profession who had grown up with him and about him, amid the difficulties and tasks—the arduous and anxious duties of a long professional life; while, at the same time, he was bound to acknowledge, in the grandeur of the gift, the recognition of Our Gracious Sovereign. While, on the one hand, he had to thank the Council and the Institute who had unanimously accorded to him the noble compliment, he had, at the same time to recognise the gracious condescension of Her Majesty in placing so high a distinction so nobly at the disposal of the Institute. (Applause.) In looking back over a long professional life, now drawing nearly to a close, he could not help expressing his conviction that the Institute owed a great deal to his Lordship, and perhaps something to the individual who addressed them in regard to the position of the Institute itself. There was a time when there were two societies, both existing together, and both running a race inconvenient and undesirable—inconvenient on the one hand because supported by a comparatively small profession, and undesirable in many respects, but principally because it increased that which belonged, more or less, to all professions,—a certain amount of professional jealousy. At the period he referred to he felt that he held an honourable position in the Architectural Society, as its President; but, at the same time, though he had the ambition of being there, and felt proud of that position, yet with these same feelings, he knew it was desirable that this distinction and this difference should be terminated. In the Noble Earl he found a most active supporter, meeting him in every possible way, with a view to unite the two societies; and, on the other hand, a great Prince (the Duke of Sussex), now no more, always the patron of art and science, condescended to listen to the recommendation he suggested; and co-operating with the advocacy of the Noble Earl, the two societies, he was happy to say, became one. This was the instance in which he had to thank his Lordship for his kind co-operation, and in which he (Mr. Tite) thought he had some claim for the humble part he took in it. (Applause.) From that time to this, he had been anxious to give all the time and labour and influence he could to the Institute, although frequently interrupted by the circumstances his Lordship had referred to—an active professional life, and very large professional engagements—which had prevented his doing all he desired; but he felt in the compliment paid him that night that the Institute itself declared he had at least done something towards the interests of the Institution to which he had the pleasure to belong. (Applause.) The strife of politics and party had little to do with the quiet pursuits of peace; but he was induced to forego the honour of being at his Lordship's last annual gathering at the invitation of a large con-

stituency—that of Bath; and he felt that in gaining that seat he had obtained a position that any Englishman would be proud of, and that it was one of the highest privileges that any gentleman could possibly obtain—the unbought suffrages of a large and enlightened constituency, enabling him to assume a place, humble as he was, in that legislative assembly that ruled the destinies of Europe. (Applause.) He hoped that the event of yesterday—the announcement of peace—declared from the cannon's mouth throughout the metropolis, and which made every heart throb with joy, would enable the Legislature of this country to turn their attention to the arts of peace, education and refinement, and that the statesmen and ministers of the day would henceforth show the world that we were just as powerful to excel in the arts of peace as our own countrymen were great and noble in the art of war. (Applause.) The remembrance of the royal gift, presented to him that day, would induce him as long as he lived to do all that he could to promote the best interests and support in every way the advantages offered to the profession by the Royal Institute of British Architects. (Loud applause.)

ON OPEN FIRE PLACES WITH REMARKS ON THEIR CONSTRUCTION.

By S. E. Rosser, C.E.

Read at the Ordinary General Meeting of the Royal Institute of British Architects, April 14th, 1856.

In a climate such as ours, subject to greater vicissitudes of temperature than occur in most other countries, the open fire-place is not the least important of the means by which these disadvantages are partially overcome. It is a subject of frequent remark that people complain of cold in an apartment maintained at a temperature of sixty degrees by the introduction of warmed air, while no fault is found if the room has an open fire although the temperature may be four or five degrees lower.

The principle objections to the open fire-place as ordinarily constructed, are the large expenditure of fuel in proportion to the effect produced, and the difficulty of warming an apartment equally and effectually. According to Dr. Franklin, not more than a fiftieth part of the heat generated was rendered available for warming apartments when he resided in England (1725); somewhat later (1798), the loss was estimated by Count Rumford at fourteen fifteenths, and recently by Dr. Arnott at seven eighths of the whole quantity consumed.

The heat which escapes in the smoke is computed at more than one-half; the loss by the warmed air of the room constantly entering the chimney above the fire is said to be two eighths, and one eighth of the fuel is supposed to pass away unburnt in the smoke.

In reference to the unequal heating at different distances from the fire, it is observed that the effect of radiant heat is inversely as the squares of the distances; so that the walls of an apartment are scarcely heated and therefore reflect no heat on persons in the room, who, if they sit at a distance from the fire, are too cold, and if near it, are too warm. More serious causes of objection are the cold draughts created by the air rushing in through the crevices of the doors and windows, and playing upon the backs of persons sitting round the fire; or forming a cold bath several inches in depth on the floor, in which their feet are constantly immersed. Another objection, but hardly a just one, is bad ventilation. That the usual mode of ventilating a room by the air escaping from it up the chimney is not the most perfect, may be admitted, but it is at least a tolerably efficient method, and infinitely superior to that afforded by the thermometer stove, or any of the varieties of Russian, German, American, and Swedish stoves; being objectionable rather on account of certain contingent disadvantages than of its inefficiency.

The last objections are the smoke and dust.

All these objections applied, more or less, to most of the open grates in general use when Dr. Arnott's Treatise on Warming and Ventilation was published, or to the flues or fire-places provided for them, and they have been received by many as conclusive against the open fire-place being worthy of adoption, as a mode of warming, in a scientific age.

It is the object of this paper to show by what improvements the open fire-place has been, or may be, rendered less obnoxious to these objections, and of more enlarged utility.

Among the first who directed attention to the improvements of the domestic hearth, Count Rumford is the best known in this country. The alteration which he made was very simple, but its success had the effect of re-modelling all the arrangements of the fire-place, and it has been the parent of the numerous register stoves now seen, which have swept away the goodly chimney corners and wide open fire-places of our ancestors.

This change was effected by contracting the throat of the flue. Within the large cavity of the chimney opening he formed, as it were, a second fire-place by building a wall in front of the chimney back, and so much in advance of it, that when carried up to the level of the arch at the back of the mantel, a space of not more than four inches was left for the depth of the throat from the back of the arch to the face of the new wall. He then contracted the opening over the fire by placing upright covings of brick in each interior angle of the recess. These formed an angle of about 135 degrees with the back of the fire; the distance between the re-entering angles of the covings being in no case greater than the width of the perpendicular part of the flue. By this arrangement the area of the throat of the chimney was reduced to seventy-two inches, and in many cases made even a third less.

To facilitate the sweeping of the flue, the upper part of the back wall was formed with a slab of stone, or fire tiles, which could be pushed back to allow a boy to pass into the flue, and afterwards replaced.

The immediate results of these alterations were the entire prevention of smoky chimneys, increased heat thrown into the apartment, and a degree of general comfort previously unattainable.

Soon after Count Rumford's fire-places had become known, register stoves having somewhat the same appearance were introduced.

Their elegant design, in iron and polished steel, and Rumfordised form, did not obviate the bad effect of substituting metal for non-conducting material, fire-brick.

In these stoves the metal back of the grate would soon be destroyed if the heat were not rapidly carried off by the air on the other side, in the cavity purposely left behind the stove which communicates with the chimney. The very circumstance, however, of the iron back being preserved by constantly parting with the heat received from the fire to the air behind it, prevents the fuel in its vicinity acquiring the temperature necessary for perfect combustion. In a grate with iron sides and back, the fuel in contact with the iron is always seen black on the edges, and the fire cannot be made to burn vividly, or without forming smoke. But when the grate is lined with fire-brick (which is a bad conductor), of considerable thickness, the brick retains the heat imparted to it by the incandescent fuel, upon which it re-acts, until the fuel and fire-brick are heated up to a clear bright fire, free from smoke and presenting a mass of radiant incandescence, having three times the power of a grate holding the same quantity of fuel but lined with iron. Very little heat can be obtained by radiation from a small fire in an iron grate, but a very small grate lined with fire-brick will give out a large quantity of heat, and less of the fuel escapes up the chimney.

A very cheap, efficient, and handsome fireplace may be formed on the model of Count Rumford's by filling the chimney opening with what is known in the trade as a "sham," *i. e.* the front of a common register stove without any of the ironwork that forms the body. The place for the fire is formed by building up the sides and back with fire-brick, and giving to each coving an angle of about 135 degrees with the back. The bottom grate is from five to seven inches deep from front to back, according as the front bars are straight or curved; and the brickwork at the back slopes upwards for about twelve inches from the bottom grate, and is thence carried up with the covings as high as the centre of the arch over the chimney opening. At this level the throat of the flue is contracted by fire-tiles, stone, or an iron plate, to a breadth from front to back of about four inches.

The sweeping machine generally renders the moveable slab unnecessary. If, however, free access to the flue above the throat is required, the contraction can be made with an iron plate, hinged to the back of the front, like the top flap of a common register stove.

Count Rumford made the flue opening into the chimney as nearly as possible perpendicular over the burning fuel. The discovery that this is not an essential condition has of late years led to the

introduction of an entirely new class of stoves, in which the fire-place is closed completely over at top, and the smoke passes into the chimney through a luffered opening at the back.

Both the last-mentioned stoves throw out an amount of heat, which few register stoves with fire-places of the same size are capable of emitting.

That the position of the fire near the hearth is of the utmost consequence to the efficiency of any grate is now universally acknowledged. This position lessens the direct radiation upon the faces of persons sitting near the fire, and throws more upon the legs and lower part of the body. The property of warmed air to ascend renders it necessary, for the general warming of a room, that the fire should be as low as possible, because heat, though readily carried upwards, cannot be communicated downwards. Hence the difficulty with the old fashioned grates, mounted up fifteen or eighteen inches from the floor, of heating the air of the room below the seats of the chairs.

But an attempt has lately been made to revive the fashion of putting the fire half way up the chimney, and it has been argued that when it is considerably above the floor it will be in a better position to radiate downwards than when nearly on a level with it. This argument, however, is based upon an imperfect appreciation of facts. If the fire were a globular body, equally incandescent over its whole surface, the amount of heat radiated from its underside would be as great as that thrown upwards or forwards. No fire-place, however, that has yet been constructed is equally incandescent on all sides.

The Staffordshire fire-place, as it has been termed, is the nearest approach to the globular form, and it throws out more heat from its under surface than any other fire-place. The bottom of an ordinary grate is a mass of iron-work, which intercepts any amount of radiation, and this iron-work does not even become tolerably warm, because it is kept cool by the current of cold air rushing over it to feed the fire. Moreover, the space between the bottom bar and that immediately above it is commonly filled with dead ashes and dust, which materially impair the efficiency of this part of the fire, even to radiate heat in horizontal lines. The more we consider these facts, the more we shall be convinced that it is only the upper surface of the fire, and that portion of the front which is comprised between the two upper spaces of the bars, that are of any value in regard to radiating power.

The restoration of the fire to its old position on the hearth led to the innovation of placing the aperture for the escape of the smoke at the back of the grate instead of over the fire. In Sylvester's grate, the opening into the chimney is at the back, and it is provided with a series of louvres, which can be opened or closed at pleasure. The draught is always strongest through the lowest of these openings, two of them (giving in ordinary cases an area of about from twenty to thirty inches) being generally sufficient to carry off the whole of the gaseous products of combustion. The upper louvres may be opened to give increased ventilation where no other outlet is provided. As less air escapes up the chimney in this grate, the indraught of cold air is proportionately less, and as the low position and the extensive radiating surface allow the calorific rays to penetrate to the lowest level of the apartment, the entering air derives a larger portion of heat from the floor in its passage to the fire. Experience has proved that this stove is capable of producing about double the effect of an ordinary register, with an equal quantity of coals. Estimating the amount of heat radiated at fifty per cent. of the calorific power of the fuel, and measuring the superfices of uninterrupted radiating surface from the burning fuel and from the sides and back of the grate, we conclude that the amount of heat radiated from this grate is not less than three-eighths of all that is evolved in the process of combustion. Since the invention of Sylvester's, several stoves have been introduced, which possess considerable merit, and mark a tendency to adapt a principle of construction essentially different from the great improvements of Count Romford. Stevens', Wright's, and Jobson's, are excellent specimens of this class.

A kind of stove lately revived and commended by Dr. Arnott, for its smoke burning qualities, is an exception to the present general practice in regard to the height of the fire above the floor. This grate might, however, be rendered even more efficient in its heating powers, and its unsightly appearance obviated, if the coal box, which occupies the lower part and really causes the high position of the fire, were made to descend into the back hearth, where depth for the purpose may generally be obtained.

Previously to Count Rumford's improvements, various plans were suggested for modifying the construction of fire-places. The principal seem to have been directed to increasing the amount of radiation from the burning fuel. Sir John Winter's (1658), and Prince Rupert's (1678), are good examples. Perhaps the most scientific series of experiments was conducted by Cardinal Polignac, who, in addition to contrivances for increasing the amount of direct radiation, made use of reflectors to throw the heat into the apartment. His useful Treatise, "La Mechanique du Feu," Amsterdam, 1714, contains the following passage:—"It seems that those who have hitherto built, or caused chimneys to be built, have only taken care to contrive in the chambers certain places where wood may be burnt, without making a due reflection that the wood in burning ought to warm those chambers, and the persons who are in them." The first part of the treatise is devoted to the fire and the interior disposition of the front part of the fire-place for the purpose of augmenting the heat. It states that there are three ways in which the heat of the burning fuel is made effective for warming a room: by direct radiation, by reflection, and by conduction and transmission. Examples of fire-places are given, in which the quantity of radiated heat is increased by parabolic reflectors of iron or brass placed in the jambs of the fire-place. The second division treats of the interior disposition of the back part of the fire-place, and of using the conducting property of iron to transmit a portion of the otherwise lost heat of the fire and smoke to atmospheric air, the properties of which are considered well calculated for conveying heat from the surfaces of the metallic substances round the fire to distant parts of the room. Several fire-places are described, in which the back, jambs, and hearth, are made with hollow spaces, or caliducts, for the purpose of warming a copious supply of external air, afterwards admitted into the room by an opening controlled by a valve or regulator. The variety of modes in which this plan may be applied renders it extremely valuable. Adjoining rooms may be heated from one fire-place in the partition wall; for by making a fire in one room the heated air from the caliducts may be discharged into the other, or the warmed air may be conveyed to any of the upper rooms.

The Polignac fire-places were constructed for the consumption of wood fuel, but Dr. Desaguliers modified them so as to admit of coal being burnt. His fire-places were much appreciated for a time, but subsequently fell into disuse, from the supposition that they burnt the air. It is possible that the more intense combustion of a coal fire in a grate might give to the iron plates that formed the sides of the caliducts a higher temperature than they had in the Polignac fire-places, but with the large proportions which he gave to his air channels this result might be avoided.

Many contrivances similar in principle to Savot's (1626) and Polignac's grates, have been brought forward, and Dr. Franklin (1745) invented a stove known as the Pennsylvania stove, which combined, to some extent, the peculiarities of Polignac's arrangement with the descending flue in Prince Rupert's stove. The proportions of the caliducts, however, in Franklin's stove make it rather questionable whether it did not overheat the air. It is said of one of these stoves, which was adapted to burning coal, that it kept a room fourteen feet square at a temperature of from sixty to sixty-four degrees for thirteen hours, with a consumption of one peck of coals, the external temperature being twenty-eight degrees.

M. Peclet's work, "Traité de la Chaleur," chapter 13 contains descriptions of several fire-places

for utilizing a portion of the heat which passes off with the smoke, by applying it to warm a supply of fresh air for the apartment.

It is possible to modify these arrangements in very many ways. The conditions to be observed are, to dispose the heated surfaces so that they may be efficacious, to give a sufficient area to the air ducts, and lastly, to render the tubes and the joints sufficiently tight, that the smoke may not mix with the warm air.

These treatises show the attention which the subject of the economy of fuel has received in other countries. It is probable, however, that in our own country there are few architects or scientific men, who have not themselves tried or seen the results of experiments conducted with the same object. It has occurred to some to increase the amount of effect derived from the combustion of fuel, in ordinary fire-places, by admitting the external air to an enclosed chamber at the back of the fire-place, where it becomes warmed by contact with the cheeks of the grate, and is then admitted into the apartment, through perforations in front of the grate. Where a spare flue exists in the chimney breast, the warm air may be conveyed through it, and discharged through an opening near the ceiling of the same apartment, or conveyed to an adjoining room, or to one on an upper floor.

An instance of the benefit derived from these or similar contrivances, though on a small scale, is worth mentioning. A building of only one story in height, in a very exposed situation, the flue from the fire-place having very little elevation, was constantly subject to smoke. The door opened directly into the open air, and on the same side there was a large window. When the fire was lighted, if the chimney drew at all, there were such currents of cold air from the crevices of the door and window, that the largest possible fire could not warm the room. The following remedy was applied: —An opening, fourteen inches by nine, was made in the external wall opposite to the fire-place, a little beneath the level of the floor joists. This communicated with the space under the floor boards. Beneath one of the jambs of the fire-place, a channel was formed communicating with a chamber on one side of the grate. The stove consisted of a fire grate and front bars, set in brickwork with splayed covings, leaving a triangular chamber in each corner, the one on the left being connected with the channel already described. Two pieces of square cast iron pipe, each four and a half by three inches, were fixed horizontally at the back of the fire, a fire-tile, two and a quarter inches thick, forming the back of the grate between them and the fuel. The ends of both pipes were open to the triangular chambers. From the top of the right hand chamber, a flue, nine inches by nine, in the chimney breast by the side of the smoke flue, opened into the room between the mantel-shelf and the ceiling. The cold air entering through the aperture in the external wall passed under the floor into the cold air chamber on the left of the fire-place, then through the iron tubes (by which it became warmed) into the warm air chamber on the right, and up the vertical flue into the room. The result was, that during extremely cold weather the temperature was raised to such a degree, that the external door was often left open when snow lay upon the ground; the chimney no longer smoked; instead of currents of cold air into the room, warm air passed out of it; and the ventilation was so good, that several persons smoking for an hour or two did not occasion any smoke to accumulate.

Air flues constructed in the chimney breasts, when a house is built, would materially promote the comfort of the inhabitants. These flues might have openings at bottom communicating with the external air, and if they were carried up alongside the smoke flues from the different fire-places, or connected with the void spaces round the grates, a considerable portion of the waste heat, usually escaping by the chimney, would be communicated to the air in the flues. Apertures should be made into them at their upper part to communicate with the various rooms, and a continuous supply of tempered air might thus be provided to maintain salutary ventilation, to supply the requisite quantity of air to the fires, and to afford an increased degree of warmth.

Chimney openings have not generally sufficient depth to receive grates of the most efficient kind. The practice of making the breasts project into the room, and the necessity for restricting the projection to the smallest limit, have led to the modern custom of making the recess of the chimney opening only a brick and a half in depth. If all the flues were built in the party-wall, no chimney breast would be required above a projection of a brick, or half a brick at the fire-place itself, which might be concealed by, or form part of the chimney-piece.

Where fire-places are situated in an external wall, the difficulty of providing a supply of air is not felt, as a hole may generally be made directly through the wall at the back; but as in town-houses they are generally formed in the party-walls, independent flues must be brought up for the purpose by the side of the chimney breasts, and openings cut through the jambs.

Where there are several stories, it would be difficult to supply air to the upper rooms, as the smoke flues from the lower rooms would generally interfere between the air flues and the fire-place. In some cases, an air flue might be formed in the floor by using the space between two joists in connection with a grating in the outer wall, and carrying an iron pipe, three or four inches in diameter, under the hearth through the trimmer and trimmer arch into the space behind the fire-place. This arrangement, however, requires the trimmer joists to be strengthened, and in London, the Building Act might probably prevent it, while the supply of air so obtained would be less than is desirable. It is, however, possible in most cases to make some arrangements for the supply of air; but it would be preferable that adequate provision should be made in all new houses, either by air flues in the party-walls, or by other modes which will suggest themselves to the architect.

Referring to Cardinal Polignac's statement as to the three modes in which the heat of burning fuel may be rendered serviceable for warming, viz., by radiation, by reflection, and by conduction; we have seen how they may be combined to produce an effect very different from that of the stoves to which Dr. Arnott's remarks applied.

By the use of fire-brick linings, and by placing the aperture for the escape of the smoke at the back of the fire, we increase the intensity of the combustion, and the consequent radiation.

By the use of reflecting surfaces, we ensure nearly all the radiated heat being directed into the room.

By placing the fire upon the hearth, and by properly arranging the conducting materials, we greatly increase the amount of radiation, and destroy the cold foot bath which accompanies a fire raised much above the floor; while by introducing warm air chambers and caliducts, we abstract a large portion of heat from the smoke, and employ it to warm a supply of fresh air for the room, which prevents cold chink winds, one of the principal objections against the open fire-place, and corrects the tendency to unequal heating which arises when we depend on radiated heat alone.

By diminishing the quantity of air escaping up the chimney, we reduce its liability to smoking.

By the use of sunk ash-pits or concealed ash-pans, in conjunction with low fires, we prevent the dust being diffused into the room.

As regards bad ventilation, it is by no means evident that this asserted objection to the open fire-place is correct, but granting that the fire-place ought not to be the only means, modern practice has given us numerous contrivances by which efficient ventilation may be obtained, while on the other hand it is certain that so long as we allow the fire to draw its supply of air from the room, we must have some ventilation. As much disappointment is often occasioned by the want of knowledge as to the points which constitute a good stove, the following remarks are offered in the hope that they may be found useful.

1. The fire should be as near the floor as possible.

2. The opening of the front should be low.

3. The grate should be lined with fire-brick.

4. A shallow fire with a large upper surface is better than much front with a contracted upper surface.

5. A stove from which the smoke escapes from the back is better than one from which it rises directly into the chimney.

6. A contrivance for regulating the quantity of air escaping up the chimney is very desirable.

7. The use of a blower in any form is only waste of fuel.

Guided by these rules, a purchaser would choose Sylvester's, Stephens', Wright's or Jobson's stoves before all others ; while a combination of the reflecting surfaces of the body of Stephens' with the radiating hearth of Sylvester's makes the most efficient and economical stove that has yet been manufactured. Caliducts for heating the air may be applied to all these stoves at a small cost.

The stoves recommended are adapted for the principal apartments, but, as they are expensive, the bedchambers and inferior rooms may be provided with good register stoves.

In a register stove the fire should be fixed as low as possible, the top bar being not more than eleven inches from the hearth, and the opening in front not more than thirty inches wide, and of about the same height in an ordinary apartment.

The cheeks should be set at an angle of about 135 degrees with the back, and polished to make them better reflectors. The fire should not be more than six inches high, and eight and a half or nine inches deep from front to back ; the back and sides being lined with fire-brick. Its projection should be confined within the line of the front when the products of combustion pass directly upwards ; but when they escape through luffers, or a door at the back, the fire may be brought more forward, the limit being the danger of a cross draught if the projection exceeds three or four inches.

For plainer fire-places, nothing better can be used than the sham register front with fire-brick cheeks, on Count Rumford's plan.

The following rules for setting stoves may be found of service.

1st. To let no air enter the flue, except what passes through the opening provided for the escape of the smoke. If it be desired to have a ventilating opening into the flue from the upper part of the room, the propriety of forming it will depend upon the draught which ordinarily exists in the flue. It will generally be better to use an unoccupied flue for the purpose of ventilation.

2nd. The grate should be kept as much forward into the room as is consistent with appearance. It is a mistake to suppose that it is more likely to smoke when brought well forward than when pushed back into a recess, provided cross draughts are avoided.

3rd. The flue in common register stoves should be brought down of equal dimensions perpendicularly over the fire, the register contracting the opening at the bottom, or, where the escape of smoke is at the back, the flue should be brought down at the back of the grate, and be made perfectly air tight.

The gathering wings usually constructed over the openings of fire-places are perfectly useless.

In conclusion it may be remarked, that with the improvements introduced into modern grates, the heat afforded for the warming of a room ought materially to exceed the proportion stated by Dr. Arnott, whose observations seem to have been made upon stoves of an imperfect construction.

In answer to an enquiry, Mr. Rosser said that the Staffordshire grate was commonly used in road-side inns and farm-houses in the Midland Counties, without the accompaniment of a fender. The first impression of such a grate would be that the chimney *must* smoke, the whole of the fire

being beyond and in advance of the flue, whereas he had never seen one which did smoke. The same thing might be seen in Sylvester's grate; and he presumed that the body of air in the room, pressing towards the aperture, deprived the smoke of its tendency to escape into the room, and thus forced it up the flue.

Mr. Scoles, Hon. Sec., observed that the success of this kind of grate was the more remarkable, as the fire was exposed to all kinds of cross draughts.

Mr. Rosser stated (in reply to the Chairman, Mr. T. L. Donaldson, H.S.F.C.), that if the grate receded instead of advancing, there would be far less radiation.

Mr. Baker, Associate, remarked that the Staffordshire grate was alluded to under the name of the Pot-house grate by Vernon, who suggested that a hood should be placed over the front of it, in order to reflect the heat into the room.

Mr. Scoles considered that a hood would prevent the pressure of the air adverted to by Mr. Rosser.

Mr. T. H. Wyatt, Fellow, referred to a grate in the office of Mr. Burn, Fellow, which was subject to a cold down draught, the supply of air for the fire being taken from outside the house.

Dr. Arnott, Visitor, observed that the subject was a very extensive and interesting one. The theory and principles of combustion were frequently quite opposite to the facts which occurred in the action of chimneys. He had no doubt that with some further study of the subject some of Mr. Rosser's opinions would become changed. With regard to low fires, it would be found by placing a thermometer on the floor, that a fire on the hearth did not dart a single ray of heat upon the carpet. The whole of the heat of a low fire would be found to ascend, and the feet of the people sitting in front of it became cold. Many of the opinions advanced on the subject of fire-places were no more true than the old opinions, that the sun rose and set instead of the earth turning round. M. Peclet, whom he had seen in Paris, had told him that the normal condition of all the chimneys in Paris was to smoke. The dearness of fuel caused the people there to keep their fires half smothered, and to shut the inside of the chimneys and let the smoke into the room. The smoke, indeed, was made so cold by the channels round the fire that the necessary intensity of ignition was prevented; so that less heat was obtained from the fire, and the smoke was so cold that the external atmosphere was not sufficient to make the chimney act. The tops of all the chimneys in Paris exhibited in a striking manner the distress of the inhabitants, by the great variety of cowls which ornamented them.

The Chairman inquired whether Dr. Arnott went so far as to say that the higher the fire was raised above the floor the warmer the room would be?

Dr. Arnott said within certain limits. He described the effect produced by substituting, in his own drawing-room, a low fire-place (the very best which a good ironmonger could supply) for one that was raised above the floor. He found with the low fire the cold affected his feet most severely. He considered a grate should be raised about fourteen inches from the floor.

Mr. Smith, Hon. Mem., observed that there was scarcely any subject which had been so much discussed, or upon which so many conflicting opinions were entertained, as on the question of warming domestic apartments. Even in the operation of stirring a fire, almost everybody considered his own plan the best. He referred to a grate in which the fire was made upon a polished iron hearth without any grating or aperture beneath to feed it, and the result was perfectly satisfactory; the fire drawing remarkably well, and giving out a very considerable heat. The same plan, however, had been tried, on his description of it, at another place where it had not answered at all. The cowl, as an appendage to the chimney shaft, was not peculiar to Paris. It was as common as possible in London, and even the chimneys of Buckingham Palace were not exempt from it. The horizontal shelf behind the Staffordshire

grate he considered a very good contrivance. Most of the inns and many private houses in Yorkshire had a similar arrangement, the shelf holding a sufficient quantity of coals to last all day. Reasoning upon this arrangement, he had been induced in his own house to adopt the plan of warming the coals beneath the grate before placing them upon the fire, and he found the combustion more perfect, and the smoke much less in consequence. His fire-place was upon a plan of his own,—the front of the bars being in a line with the front of the chimney-piece, and therefore in advance of the walls of the room. This grate drew exceedingly well, but was liable to disturbance from cross draughts.

Dr. Arnott assented to the importance of warming the fuel before placing it on the fire.

Mr. T. H. Wyatt referred to a case in which smoky chimneys had been caused to a great extent by the defective pointing of the brickwork of a large stack of chimneys. He had rebuilt these chimneys, forming the part above the roof with hollow bricks, which he found had a very good effect.

Mr. Nash, Associate, stated that in his own practice he had introduced cold air at the hearth, and found it to cure a smoky chimney. It might be thought that the introduction in this way of air that had not been previously warmed would be inconvenient, but he had not found it so. Even if the quantity of air so introduced was very great indeed, he found, on opening a window at the top, that the air instead of coming in was going out; the fire rarefying the air so much that it overbalanced the indraught at the window. He had adopted this plan with complete success in a room, the chimney of which had previously smoked. He introduced the air exactly in front of the fire by two perforated copper boxes, or in other cases by a grating with a large air chamber under the hearth; though the latter plan was rather objectionable, inasmuch as it became in some degree an ash-pit.

The Chairman sketched and described a grate in his own dining-room, constructed by Mr. Cundy. It had a back of fire-brick inclined forwards. The air was brought from outside the room through a channel and escaped immediately under the grate. The heat given out was considerable, and the room, though spacious, was perfectly warmed.

Mr. Baker mentioned a case in which he had adopted one of the Farnley Company's fire-brick fire-places in the shape of a niche. The hearth, which was of fire-brick, was raised three inches above the floor; cold air was admitted underneath. The fire-place was made upon Leslie's principle, without any false front. The fire-brick consumed the smoke that was generated; but he found it was necessary to keep the hood thrown back, in order that the smoke might pass up the chimney. This stove, which was twenty-two inches wide, warmed perfectly a room of forty feet by twenty-four. The fire-brick itself was not however a satisfactory specimen.

Mr. Nash, Associate, confirmed Mr. Baker's statement as to the heat given out by the Farnley stoves, which he had seen used in Yorkshire. The fire-brick getting hot, the heat was powerfully radiated into the room from the dome.

The Chairman moved the thanks of the meeting to Mr. Rosser, which was unanimously agreed to, and the meeting then adjourned.

ON THE RESTORATION AND PRESERVATION OF WOOD CARVINGS.

A Communication from Henry Crace, Esq.

Read at the Ordinary General Meeting of the Royal Institute of British Architects, April 28th 1856.

Being much interested in the preservation of the various beautiful carvings of this country, more particularly those of the seventeenth century, I have considered that it might be of use to the Members of the Institute, to submit for their inspection a specimen of some I have lately restored for the Worshipful Company of Mercers, in their Hall, which was rebuilt after the Fire of London, in 1666. These carvings having gone completely to decay, I was requested by the late Master, William Barnes, Esq., a Member of your Institute, to examine and report what I could do to restore and preserve them. I found the whole had been removed out of the Hall, the architect fearing they might fall from the panelling, as they were worm-eaten in parts into perfect dust, and principally kept together by the large quantity of paint, varnish, &c., they had received from time to time. The piece of carving I have placed on the table I have obtained permission of the Company to take down for your inspection. Had I contemplated submitting it to the Institute, I would have done so before I restored all the panels, that a more correct idea might be formed of their actual state of decay. I have, however, obtained a small piece of one of the leaves which Mr. Eugene Barnes, Clerk to the Company, had preserved, and placed under a shade to show the perfect honeycomb the wood had been reduced to when the dust was blown out; also a portion of dust in a bottle—the work of the insects which had destroyed the wood. The main stem being of deal, the fruit, flowers, &c., are of lime, pear, and beech. The leaf of pear-wood I have partly cleaned, to show the Court of the Mercers' Company that had the carvings been more perfect and wholly of oak, or any one wood, I could have restored them to their primitive colour and freshness.

It may now be necessary to explain what has been done to it. The carving is of the same colour as when taken down. I merely washed it, and with a gimblet bored a number of holes in the back, and into every projecting piece of fruit, and leaves, on the face, and placing the whole in a long trough 15 inches deep, I covered it with a solution prepared in the following manner:—I took 16 gallons of linseed oil with 2lbs. of litharge finely ground, 1lb. of camphor, and 2lb. of red lead, which I boiled for six hours, keeping it stirred that every ingredient might be perfectly incorporated. I then dissolved 6lbs. of bees' wax in a gallon of spirits of turpentine, and mixed the whole while warm thoroughly together.

In this solution the carving remained for twenty-four hours. When taken out, I kept the face downwards that the oil in the holes might soak down to the face of the carving, and on cutting some of the wood nearly 9 inches deep I found it had soaked through; for I should observe that not any of the dust was blown out, as I considered it a valuable medium to form a substance for the future support of the wood; this has been accomplished, and as the dust became saturated with the oil, it increased in bulk, and rendered the carving perfectly solid.

Each panel has consumed a little more than a gallon of the solution; they have been finished about five months, are becoming quite hard, and in the space of four or five years will be as hard as any wood. I have no doubt that in twenty years they will become so hard that no knife will cut them. Every gentleman present is aware that common putty becomes so hard within that period, that in hacking out a broken square of glass the wood is frequently destroyed, the putty being harder than the wood.

In my case the ingredients used will become more quickly hard, and I am confident that the carving is now more durable than the hour it left the carver's hands. The holes made by the gimlet

are left open, that the air may penetrate to assist in the solidifying of the decayed parts of the wood, at the same time we are aware that no insect can enter it, and it is impossible for any such to subsist on the composition introduced.

As a further proof of the perfect restoration I may state, that the piece of carving now on the table, while being carried by myself and a workman across the room, fell of itself from our hands and was broken into twenty-two pieces, which, however, being mounted on a back-board, the whole was restored to its original features. There are ten panels now been mounted on boards of a similar description, which, having been soaked in the solution, and profiled out and painted to match the oak panelling, the addition is not observed.

With reference to the cleaning and restoring of old carvings, I can state that my experience ranges over a period of fifty years, having commenced in the restoration of the very handsome wards of Greenwich Hospital.

Before that period it was the fashion to wash the oak compartments and varnish them, by which process, and with time and filth, they had become perfectly black, or rather of a chocolate colour. We set to work to clean them, and at last succeeded in bringing them back to their original freshness; and I believe that during that period my father had the works, and afterwards my brother and myself, every ward fitted up with oak was restored.

A more perfect restoration and cleansing on a larger scale, took place in the Brewers' Hall, Addle Street. I was sent for by the late Mr. Hanbury, to ascertain the expense of painting and graining their Hall, in imitation of oak, varnished. I found their beautiful Hall of oak one mass of dirt, the mouldings and carvings having been nearly filled up and painted old oak colour; by repeated varnishings with boiled oil, it had become the colour of chocolate, and being lighted by small windows it had the appearance of a dingy vault or cavern. The architecture is Corinthian, with the columns, cornices and shields, in wainscot. It then became a question of expense, and after consulting with the late Mr. Pocock, their architect, I agreed to restore the whole of the Hall to its original colour, with varnishing, for the same amount as it cost to paint, grain as oak, and varnish it. This was done much to their satisfaction, and afterwards led the Company to have their Court Room, &c., cleaned in the same manner. Among many others I also restored some very fine old oak panelling which had been painted white and gilt, at Gilston Park, and at other seats of the nobility who possessed carvings of a similar description. I have also restored and preserved old carvings and furniture which had become worm-eaten by the same process, previously to re-gilding them.

The Chairman (Mr. F. C. Penrose, V.P.) mentioned a case in which some carving that had been much worm eaten was preserved from further injury by dropping corrosive sublimate, by means of a pin point, into all the holes.

Mr. Crace observed that in some of the specimens before the meeting there was only a single hole in one piece of fruit, yet the whole of the interior substance was converted into powder, and the mischief could not therefore be remedied by the use of a pin point. Mr Crace illustrated by percussion the soundness to which the carvings had been restored. He had not painted them, but they had been painted at an earlier period, and consisted of different kinds of wood. The greater part of the bulk of the bottom was deal. The lime tree wood had suffered very much, the oak was materially injured but not so much as the lime, whereas the deal had suffered more than either. One portion of pear tree had not been touched by the insect at all. It had been impossible to restore the original sharpness of the carvings, as if the varnish and paint had been removed they would have fallen to pieces. The insect which had committed these ravages was a small brown beetle about the size of a pin's head.

Mr. Jennings, Fellow, considered that the beetle was the perfect form of the worm, which was in reality the eating insect. He had seen it in both conditions, and believed it did not pass through any intermediate chrysalis state.

Mr. C. H. Smith, Hon. Member, observed that the insect which was so destructive to ship timber was unquestionably a worm, but in the present instance he believed it was the small beetle described by Mr Crace, being similar (except in size) to the wood louse and the cockchafer.

Mr. Crace stated that the same insect was very injurious to apple trees, rose trees, and sycamore trees, and mentioned a case in which two acres of rose trees had been attacked by it.

Mr. Smith added that the sapwood of the sycamores and limes in the Piccadilly and in the Regent's Park are affected by its ravages. It would generally be found that the sap wood of deal was greatly eaten, whilst the heart wood, which was full of turpentine, was untouched. The process described by Mr. Crace, resembled the natural condition, and it was obvious that the insects would avoid the wax, oil, and turpentine employed in it. If such a preparation could be injected into new carvings, he thought they would be exceedingly durable.

In further explanation Mr. Crace stated that the preparation would necessarily darken the wood, in the same way as ordinary boiled oil did, and that the red lead which was boiled with the oil prevented the possibility of any insect living in it.

Mr. Jennings said that the injury sustained by picture panels proved that the mere application of oil was not a sufficient protection. Oil being rather thicker than corrosive sublimate was more likely to interfere with the sharpness of delicate carvings.

The Chairman observed that corrosive sublimate was liable to wash out.

Mr. Scoles, Hon. Secretary, stated that ships used for carrying oil, and becoming saturated with it, were not subject to the worm.

Mr. G. Foggo, Visitor, observed that turpentine was found a complete protection for picture panels, and that the combination of oil and turpentine was the best vehicle for the use of the artist.

Mr. Nelson, Hon. Secretary, called attention to the actual conversion of a fine powder into a solid mass by Mr. Crace's method. He doubted whether corrosive sublimate would produce a similar effect.

The thanks of the meeting were unanimously voted to Mr. Crace for his communication.

Mr. Nelson, Hon. Sec. read a brief description of a Patent Iron Beam invented by Mr. R. M'Connel.

In making a flooring beam according to this invention, two thin bars or plates of malleable iron are used as the top and bottom plates of the beam. These two plates or bars are disposed parallel to each other, and at considerable distances asunder—one foot, for example, more or less, according to circumstances. This dimension would suffice for a bearing of twenty feet. The space between these plates is filled in with short blocks of wood, disposed with slight spaces between each block, for the reception of the flooring joists. These blocks, or pieces of wood, are disposed with the fibre of the wood in a vertical position; that is to say, in the direction in which the wood grows. When so packed in with wood, the two plates are bolted together at suitable intervals asunder by bolts, so as to bind the whole of the details into one solid beam. The wood having no appreciable shrinkage in the direction of its fibres, the beam always remains solid, whilst the direction in which the fibres are opposed to the strain from the flooring is most favourable in point of resisting strength. Cast-iron may be used instead of malleable plates for the top and bottom portions of the beam; or one plate may be of cast-iron, and the other of malleable iron. In a slight modification of this arrangement of beam, cast or malleable iron distending pieces may be used for interposition between the two main plates. When the two main plates are of malleable iron, open diagonal or other shaped castings may be used as the supporting or distending blocks, these castings

being bolted up into position just as in the case of the wood blocks. Instead of being separate and detached blocks, the distending or stay pieces may be cast as projections upon one of the main plates or bars, the other plate being then bolted up. In any of these modifications, the main plates need not necessarily be parallel, as by using deeper blocks or stays towards the longitudinal centre of the beam, increased strength is secured. The top plate, too, may be in two or more lengths, with the junction ends abutting, or nearly so. A central key may then be driven in horizontally between these ends, so as to give a rise to the beam's central portion.

The cast-iron columns supporting the beam are formed with the usual neck and shoulder. The beam is attached to the wings or bracket arms of box or saddle pieces, which are passed upon the necks of the columns, and rest upon the shoulders. It is not necessary, however, to bolt or fix the beam or girder to the walls or to columns, as they may be made to simply rest with their ends in or upon the walls, or upon shoulders, or resting surfaces, formed upon the columns. A washer of an improved form is used in bolting together the pieces of timber, and it is designed to prevent the loosening of the bolt from shrinkage in the wood. The washer is in the form of a truncated cone, with an oval base, the narrow end of the cone being entered into a recess formed in the wood; so that when the wood shrinks, as it does across its breadth and thickness, it does not leave the washer, as in the case of the common flat washer, but merely clips it at a point a little nearer to its narrow end.

Mr. Papworth, Fellow, observed that the principle of the beam described was similar to that adopted in many old timber roofs, and had been applied by the late Mr. Thomas Cubitt to a roof of 100 ft. span.

The Chairman regretted that Mr. Donaldson was absent, as some further explanation was desirable. The beam at first sight appeared rather uncertain and treacherous, but it was quite a matter to be determined by experience.

Mr. Baker, Associate, thought the beam in question bore a strong resemblance to Warren's girder bridge. The latter, however, was lighter, triangles were used instead of squares, and there was more open space than in the beam described. Warren's bridge had been discussed and commended at the Institution of Civil Engineers.

Mr. Nelson read an extract from a letter sent to Mr. Donaldson, H.S.F.C., from Mr. Salmon, of Glasgow :—"With regard to beam, the drawings sent represent the manner in which it is executed in the iron building you and I visited. I think the arrangement for joist apertures or spaces might be improved, and a more equal strength imparted to the beam by scarfing the joists where they require to be joined, instead of passing the one beyond the other, and bolting them, as shewn by drawing. Other improvements might also be introduced." Mr. Nelson thought there must be some fallacy in the principle of making the lower portion of the beam, which was exposed to tension, of cast iron.

Mr. Papworth said he should not be surprised to find in practice that, if the upper tie were cambered by bolts, when it came to its bearing it would tear them all out.

The Chairman.—There is one subject, before I announce the adjournment of the meeting, which it is very desirable I should bring before you. It is with respect to the Annual General Meeting of the members, which is to take place on Monday next. It has for some years past happened that these annual meetings to transact the business of the Institute have been very thinly attended; and I think it is a very unfortunate state of things, because those who do come do not feel that energy and enthusiasm in transacting the business, which they would if the members showed themselves more interested in the matter. I would therefore beg that those who are now here and will not be withheld by absolute business, to attend themselves, and to ask those they may see to attend also on Monday next, because there are always subjects of importance to discuss which it is very unsatisfactory to consider at meetings so small as those which we have sometimes had.

After the ballot for the election of members the meeting adjourned.

ON THE BRIDGES AND VIADUCTS OF THE PRESENT DAY.

By John Clayton, Associate.

Read at the Ordinary General Meeting of the Royal Institute of British Architects, May 19th, 1856.

There are few public works (commercially speaking at least) of greater interest or importance than bridges and viaducts. The necessity of good roads of communication from one part of a country to another, and the impossibility of completing them without erecting bridges over streams and viaducts over valleys, have given rise not only to the works of the present day, but also to those stupendous monuments of antiquity which have been handed down to us. With the magnificent bridges, viaducts, and aqueducts of the Romans every architect must be well acquainted, and it is indeed not long since that ancient Roman roads and modern British railways were compared by a very able authority before this Institute. In consequence of the immense extension of the railway system during the last thirty years, a more extensive field of bridge building has been opened than at any previous period. The fact that in 1852 fifteen thousand miles of railway had been constructed in Great Britain alone, and that these required, on an average, three or four bridges per mile, will give a total of fifty thousand bridges, large and small.

In speaking of the bridges and viaducts of the present day, it will be hardly necessary to observe that their great and striking peculiarity is to be found in the use of iron; and though, as architects, we may be impressed with the superior dignity and proportions of stone bridges, it must be granted that iron has many advantages compared with either stone or timber, as it is much lighter and more economical in the first outlay than the former, and more durable than the latter. It must not, however, be forgotton that, although iron construction may be considered the great invention and distinguishing peculiarity of modern times, there are also some very fine works in stone, brick, and timber. In the two former, however, no progress, worthy of peculiar notice, has been made, bridges of larger span having been executed by the Romans centuries ago. The largest span in stone, executed in England, is that over the Dee of 200 feet; but ancient examples are recorded to have been from 50 to 100 feet wider, which, with reference to the age when they were executed, must have called for a comparatively greater amount of skill. It is in iron therefore, with respect to the span, that the great merit of modern works consists; the changes in the different modes of applying this material have been gradual and progressive, and very similar to, though somewhat more rapid than, the changes in the different styles of architecture. The first iron bridge was erected about eighty years ago, and partook of the character of its predecessors in stone, being formed of cast iron voussoirs or wedge shaped blocks put together in ribs. From that time to the present there has not been much improvement in the construction of this class of iron bridges, and the span has only increased from 200 to 240 feet, which would appear to be the proper limit. Soon after the introduction of the cast voussoir principle, cast iron beams were used for small spans of 50 feet, which eventually, by combination with wrought iron trussing, reached as far as 100 feet. The greatest improvement was the formation of girders entirely of wrought iron, which soon followed the production of rolled plates and bars of different forms and sections. This in a few years led to the execution of spans of 460 feet, the largest of rigid roadways with a level headway beneath, yet constructed. In suspension bridges, spans on this principle have been executed of upwards of 1000 feet. But as these, from their vibration, are quite unfit for the passage of heavy weights in rapid motion, they will not be treated on the present occasion.

Cast iron bridges may be classed as follows:—*The arched rib, the trabeated, and the combination*

girder. Wrought iron bridges consist of *the tubular girder, the tubular bow girder, the large tube,* and *lattice girders,* with several varieties of combination.

The first iron bridge constructed in England is that over the river Severn near to *Colebrook Dale.* The design appears to have originated with Mr. Pritchard, Architect, about the year 1773, and the works were completed in 1779. In this bridge five arched ribs of cast iron support perpendicular spandril pieces, which carry the roadway. The ribs are nearly semicircular and have a span of 100 feet.

Sunderland Bridge, over the River Wear, the next cast iron bridge erected, was designed by Mr. Rowland Burdon in 1792, to whom a patent was also granted, for "a certain mode or manner of making, uniting and applying cast iron blocks to be substituted in lieu of key stones in the construction of arches. This bridge consists of six arched ribs of a segmental form 200 feet span and 30 feet rise. Each rib is 5 feet deep and consists of 105 separate blocks.

Buildwas Bridge over the River Severn, by Telford, is like the foregoing a single arch, 130 feet span with 27 feet rise. It consists of three arched ribs 3 feet 10″ deep.

Boston Bridge, by Rennie, is remarkable for the slightness of its rise, which is 4 feet with a span of 100 feet.

Southwark Bridge, also by Rennie, has the greatest span executed, that of the centre arch being 240 and of the sides 210 feet. The rise of the centre arch is 24 feet, that of the side arches proportionate. The arches consist each of eight ribs 8 feet deep at the springing and 6 feet at the crown. Each rib is cast in fifteen pieces of much larger masses than in the previous works.

The New Bridge, Westminster, in course of construction, will also prove a valuable addition to this class of works.

Upon simple cast iron beams it will not be necessary to say much. The first application of this material as a beam is due to Boulton and Watt, after whom it was extensively applied in construction by Sir R. Smirke. Although useful in buildings, its fragile and treacherous character renders it hazardous for railway purposes. Capable of bearing a large amount of dead weight it can be easily broken by a cross blow or the sudden shock of a passing train. Its span has reached 40 or 45 feet, and this only under very careful treatment.

With the view of remedying the defects of cast iron girders, recourse was had to trussing them with malleable iron. Owing, however, to the unequal expansion and contraction of the two metals, and the fact that the two were seldom brought into action at the same time, the success of these beams has been very doubtful. They have been used in spans of 50 to 100 feet, but certain failures appear to have led to their disuse.

Lea Bridge was erected about ten years ago, the total length is 70 feet or 66 feet clear bearing. The girder is composed of two castings of an uniform depth of 3 feet, bolted together with wrought plates to the joints and trussing bars.

Dee Bridge, Chester, was the largest bridge of the kind; it crossed the river in three spans and had a double line of rails with a pair of girders to each. The total length of each girder was 109 feet or 98 feet clear bearing. It had an uniform depth of 3 feet 9, and was formed of three separate castings. Cast iron plates 13 feet long and 3 feet deep were bolted over the top of the joints, and a set of trussing bars was placed on each side of the girder. The thickness of the web or central part was $2\frac{1}{8}$″, the top flange 7″ wide, the bottom 2 feet. The girders sustained the usual test yet gave way under a much less load. The failure has been attributed to a variety of causes, but a not unfrequent one has been overlooked, viz., the manner in which the roadway was made to take its bearing on the girders. As a general rule, too much care cannot be taken to give the weight an uniform

bearing in a vertical direction on either cast or wrought iron girders, more especially the former. Placing the planking or beams on the inside flange will, on the passage of every weight, cause a tilting vibratory motion; if the roadway cannot be placed altogether on the top of the girder, it should be carried underneath it and suspended with plates and bolts.

Tubular Girder Bridges owe their origin to the manufacture of wrought plate iron, which was first used in ship building. Great improvements were soon made in the mode of joining and rivetting these plates, and the T, L, and double L iron, manufactured by Mr. Fairbairn, led to the great works which were carried out after its application to railway purposes.

The Liverpool Canal Bridge, on the Blackburn and Bolton Railway, executed by Mr. Fairbairn, was the first application of these girders; the span is 60 feet. *The Liverpool Landing Stage Bridge*, erected by Mr. Fairbairn for Sir W. Cubitt, spans the space between the pier and the floating pontoon in deep water. Its total length is 152 feet, and 142 feet between bearings.

The Gainsborough Bridge, erected by Messrs. Fairbairn for Mr. Fowler, crosses the river Trent at the angle of 50°. It consists of two spans each of 154 feet. There are two girders to each span carrying a double line of rails; the girders are of an uniform depth of 12 feet; the top is strengthened by a double chamber 3 feet wide by 1 foot 3 deep; the width of the girder below is 2 feet 6. The sides of the girder are strengthened by an arched rib of a double L shape, 1 foot deep; the plates are 2 feet wide and ½ an inch thick.

The Britannia Bridge, by Stephenson, has been fully described, and it is only necessary to give *chief* dimensions. It consists of four spans, the two main 460 feet, the two side 230 feet, and it is 90 feet clear of high water mark. There is a tubular girder to each line of rails, the dimensions of which are 30 by 14 feet 6. The form of this tube is square and it is stiffened at the top and bottom by small cells, which answer to the top and bottom chords of the lattice girder.

The High Level Bridge, Newcastle, also by Stephenson, forms a junction between several railways. It is remarkable for carrying a railway above and a roadway for street traffic below, and consists of six spans of 125 feet; the extreme height is 125 feet, and there is a clear opening of 80 feet above the water line. The weight is carried by arches on the level of the roadway, the bottom of which is suspended from it. The piers measure 50 by 16 feet, and are lightened by arches. The most striking and peculiar feature is seen from the roadway, which presents a series of dark arched ribs, with light bursting through the bars supporting the sides. The whole design is exceedingly good and the exterior handsome.

Before entering upon the subject of *lattice girder bridges*, it is necessary to glance at the timber viaducts, as it is from them that they derived their origin.

The most remarkable of these structures are American. The greatest span is that over *the Portsmouth river*, 250 feet; the greatest height that over *Genesse river*, 230 feet. As English examples we may mention—*Dinting Vale* with a span 120 by 125 feet, *Landore* 109 by 90. Amongst the earliest wooden bridges are those designed by Palladio, three of which have 100 feet span, two are framed on the ordinary principle of trussing, and the other on the arched rib or voussoir principle.

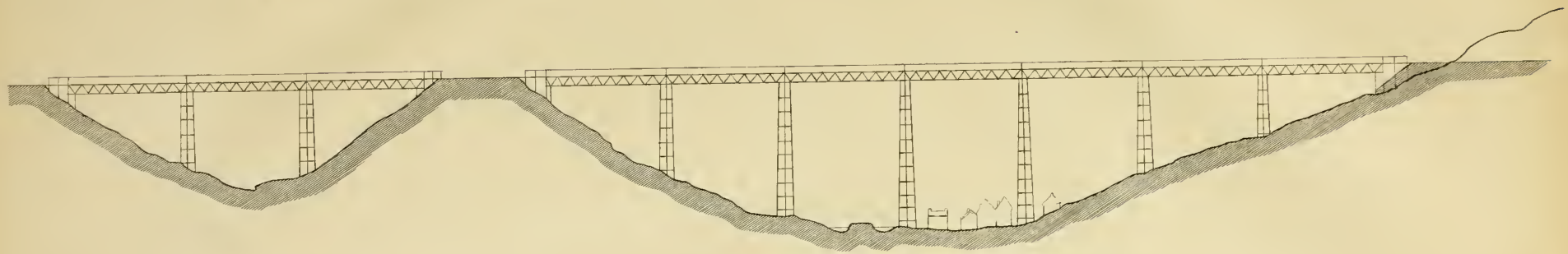
The Portsmouth River Bridge is formed on the same principle as the last, with the addition of diagonal bracing to each voussoir. *Don Bridge* near Aberdeen, is composed of a strong arched rib, in the spandrils between which and the level roadway above, is a filling in of framing distributing the pressure. *Schaffhausen Bridge* is similar in arrangement to the earliest American. The weight is carried by a series of raking struts, which radiate from one or more points on piers or abutments; they are bolted to the top and bottom chords of the girder, and transfer the weight of the roadway at regular intervals to the piers.

The Portage Timber Viaduct, the loftiest and most interesting piece of timber work of the kind, crosses the Genesse river at an altitude of 230 feet. This work, designed by Mr. Silas Seymour, was commenced on the 1st of July, 1851, and completed in a period of only thirteen months and a half. The whole length is 800 feet, the piers, 50 feet apart, are formed of wooden trestles standing on a base of stone 24 feet high. The trestles are formed of timbers 14 inches square at the base and 1 foot at the top, the braces to the piers and girders are 6″ by 12″, the number of vertical posts at the base are twenty-one, which diminish to fifteen at the top. Three rows of girders, 14 feet deep, formed of diagonal braces, support the roadway. The cost of the bridge was £35,000., the quantity of timber 135,500 feet. It was estimated that a stone bridge would have cost seven times the amount, and that the interest would renew the whole three times as often as would be required. This may apply in America, but the economy of using timber is very questionable in England.

My own professional engagement in the locality enables me to enter more at length into the description of the *Crumlin Viaduct* situated on the Newport, Abergavenny, and Hereford Railway Extension, which with the exception of the *Aqueduct of Spoleto* and the *Portage Timber Viaduct* in the United States, exceeds any other structure of the kind in height. It is a remarkable example of the modern application of iron to such purposes. The dimensions are as follow:—Total height from the bed of the river to the level of the rails, 200 feet; the piers from centre to centre, 150 feet; actual bearing of girder, 148 feet; the total length of viaduct, 600 yards. There are altogether ten spans or openings, but they are unequally divided by a tongue of land on which are placed masonry and earth-work, about 50 yards in length, making in reality, as far as the ironwork is concerned, two separate viaducts. The larger viaduct has seven spans and six piers; the smaller one, three spans and two piers. Excepting the height of the piers from the level of the valley, the two are precisely similar, and it will be necessary only to allude to the larger one. The piers are formed of clusters of cast iron columns, placed in stages. Each column is 17 feet long by 1 foot in diameter; cast hollow, the thickness of metal varying from 1 inch to $\frac{7}{8}$, diminished within, the same external diameter and form of column being preserved throughout. The number of columns in each stage is fourteen, and they are arranged on plan, in the longer direction, in four rows of three each, with one standing singly at each end of the piers, which gives it a salient angular outline. The width between the columns at the base of the pier measures 13 feet 6 in every direction, taken on the square, excepting between the two centre rows, where it measures six feet throughout the height. The pier gradually diminishes to the top of the columns below the girders, where the dimension 13 feet 6 is reduced to 9 feet, and at the external angle columns to 2 feet. The dimensions of the piers at the base are between the centres of the columns 60 by 27 feet, and the upper dimensions 30 by 18 feet, giving a diminution of 30 feet in one direction and of 9 feet in the other. To effect this, nearly all the columns are more or less inclined, and the two centre are the only upright ones. The four columns at the corners, forming the square of the piers, lean diagonally 4 feet 6. The six intermediate columns correspond, but lean each in one direction only. The two single outside columns are most inclined, being 11 feet 6 out of the perpendicular, forming a raking brace. The top of each stage of columns is connected by horizontal cast girders 1 foot deep, with 5 inch flanges, bolted together. There are also horizontal and vertical wrought tie rods. The former are circular, and 2in. diameter, and the latter flat bars, $4 \times \frac{3}{4}$. They are tightened with wedges where necessary. The columns are fitted together with socket joints, a projection of half an inch being left on the top of the cap, which fits into the base of the column above. These are held together by four ears cast on the top and bottom, which are fixed with bolts and nuts. The joints of the columns are planed and fitted together with the greatest nicety to ensure a perfect bearing. The base plates upon which the

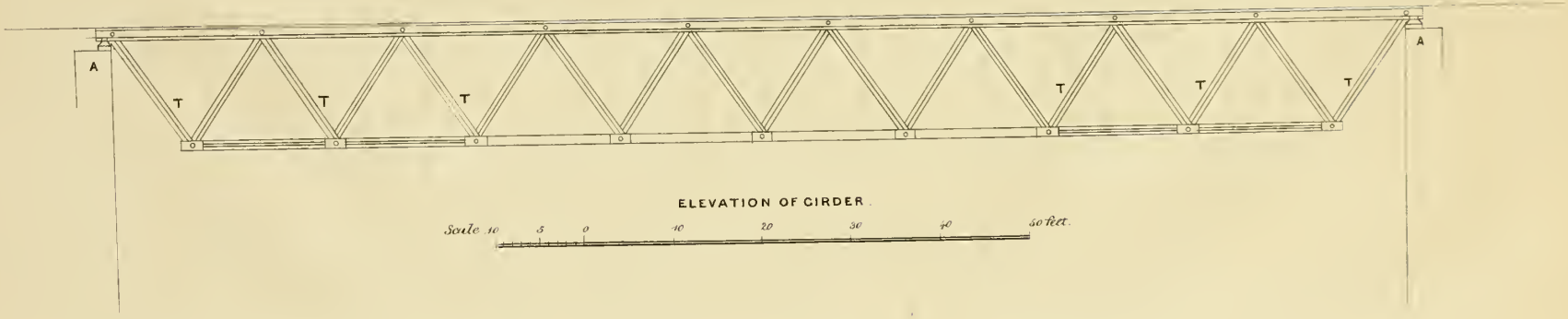
THE CRUMLIN VIADUCT.

Newport, Abergavenny and Hereford Railway Extension to Taffe Vale and Swansea.



ELEVATION.

Scale 100 50 0 100 200 300 400 500 feet



ELEVATION OF GIRDER.

Scale 10 5 0 10 20 30 40 50 feet.

A.A. *Blocks supporting Girder.*

T.T.T. *Principal Ties.*

columns stand vary from 3 feet to 5 feet in height, and have a plate 3 feet square resting on the masonry, into which they are joggled, plugged, bolted, and put together with sulphur joints. The number of stages of columns to centre piers, it will be perceived, are ten, without base plates. The upper stages of the columns are connected together at top by stronger horizontal girders than those below. They are finished with A shaped or triangular trusses placed over each row of columns below, upon which the girders rest. It should be mentioned that the foundations for the piers are formed of solid, flat bedded and jointed masonry; they were generally carried down to the solid rock, and vary from 10 to 3 feet in depth. The largest blocks are placed immediately under the base of the columns and so arranged as to distribute the weight below as much as possible. The girders are formed of wrought iron after Warren's patent. This consists of a stout beam above, and a bottom tie below, with diagonal filling in, the whole being supported by the top beam on the principle of an inverted truss, the mode of execution, however, differs much. The girders at the Crumlin are 150 feet long and 14 feet 6 deep, outside dimensions. The dimension of the top tubular beam is 14½ inches by 9; the average thickness of the plates being, the sides an inch, the top and bottom half an inch. The sides have flanges formed on the edges, which are rivetted to the top and bottom plate. Extra stiffening pieces are carried along the bottom, and likewise the joints and where the bolts cross. The ties at the bottom of the diagonals of the girder are formed of a series of four wrought bars, 6″ by ⅝″ average, placed in pairs 3 inches apart in the centre to admit the diagonals and packing, and shewing a 4 inch separation on face; the whole forming a square combination measuring 16 inches by 7; these bars reach from diagonal to diagonal, where they are all four joined with a plate 16 inches deep, and bolted with five ⅞ rivets to each. There are eighteen diagonals to each girder, which act as struts and ties until they gradually approach the centre, where they act as both. The diagonals do not cross each other, as is the case in the lattice girder, but are both fixed to the top beam and bottom tie with large bolts 3½ inches diameter; and it is on the care and security with which these parts are connected that the chief strength of the girders depends. The diagonal ties and struts present a different section, the main strut being of a cross shape, measuring 10 inches to each extremity, cut out of ⅞ plates, with four 5 inch L angle pieces rivetted. The ties are formed of two flat iron bars 9″ by ½″, which lap the struts, where they are rivetted, top and bottom. The ties near the centre, extending two on each side, are strengthened by smaller pieces of T iron, to enable them to act in some measure in the double capacity of ties and struts. The part of the lower beam or ties between the four centre strains of diagonals is strengthened by an additional bar 4″ wide, filling the space between the other bars, and rivetted like them to the junction plates. The whole girder is gradually strengthened by an additional thickness of plates towards the centre, given by a close calculation of the forces required to be resisted. The side plates of the girder and ties diminish from 1 inch in the centre to ⅝ at the ends. Each pair of girders is connected at each of the large bolts or pins with a 5″ cast iron hollow bar, with ½″ thickness of metal. The bolts are passed through the ties, diagonals, and packing pieces, leaving the heads outside, the ends of the pin projecting about an inch; the end is then covered with a cast iron cap, which is screwed or bolted with a 1½″ screw into the centre of the pin, to prevent the same from drawing out. This affords a means of connection with the cast iron bars by corresponding flanges, which are firmly bolted together. The bearing of the girder, by which the whole is sustained, is worthy of particular notice. It is held by the ends of the *upper beam only*, the lower one dropping in a state of suspension; the weight thus entirely rests on the last pin, which passes through the outside diagonal tie. The top of the angular termination of the piers is furnished with a casting 3 feet 6 long and 5 inches wide, on the upper surface of which is a flat sinking ¾″ deep. Under the ends of the upper beam are placed cast iron blocks, hollowed out on the upper surface to

receive half the diameter of the pin, and of sufficient depth to raise the bottom flanges of the beam clear of the sliding groove. This block has perfect freedom of play backwards and forwards to suit the expansion and contraction of the girders as affected by the temperature of the atmosphere or the superincumbent weight; for this purpose a space of 9 inches is likewise left clear between the ends of the beams. The ordinary expansion and contraction in summer, between midday and midnight does not exceed a quarter of an inch. The girders have been tested with a weight of 250 tons each, which produced a very slight deflection; and were the viaduct loaded with locomotives this would be seven or eight times as much as could be put upon them. The struts have also been tested with a crushing weight of 250 tons. The roadway is formed of 6 inch planking bolted to the beams, and it is intended that the rails should be laid on strong longitudinal framed sleepers. An ornamental cast iron balustrade is fixed on each side of roadway. The whole viaduct is not straight on the plan, the approaches to the larger one being curved, to which the last spans of the viaduct accommodate themselves by a slight inclination southwards at the extremities. This viaduct has been described as one of the engineering wonders of the day, and it may be mentioned, that another projected by the same engineers, is of a much greater height. Messrs. Liddell and Gordon, were the Engineers; Mr. M. W. Carr, the Resident Engineer; Messrs Kennard, the Contractors.

The *Sitter Viaduct*, on the St. Gall and Appenzel Railway, an account of the completion of which has just appeared, is one of similar construction except that the girders are lattice. It is close upon the same height and has four spans, the two centre being 138 feet, and the two side ones 130 feet, but on the whole is a work of less magnitude than the Crumlin.

The *Newark Dyke Bridge*, crosses in one span a branch of the Trent at an angle so oblique as to render it necessary that the girder should be 240 feet 6 long, whilst the width measured on the square between the abutments is only 97 feet 6. This is also one of Warren's patent, but differs materially from the Crumlin, inasmuch as the top tube and the parts compressed are of cast iron. Each line is carried by a pair of girders 13 feet apart, between which the trains run. The top tube or strut is composed of twenty-nine cast iron pipes 13 inches diameter, the thickness of metal $1\frac{1}{2}$ inch. The ends of these are turned and nicely fitted together and bolted; the cast iron struts are of the form of a Maltese cross. Each girder weighs 122 tons 10 cwt., the whole bridge, including the platform, 589 tons. The deflection caused by two heavy goods engines travelling both fast and slow (60 tons weight) was $2\frac{1}{8}$ inches. This bridge was erected before the Crumlin, and although the span is greater, the preference must be given to the latter as being composed entirely of wrought iron.

Chepstow Bridge, over the River Wye, by Mr. Brunel, is a remarkable example of the combination of the tube and girder, to which may be added a third principle, that of suspension. The whole length of the bridge is 623 feet, one half of which is crossed by a viaduct girder of three spans, the remaining portion by a single span of 296 feet. The central pier is composed of six cast iron cylinders 8 feet diameter below, placed in two rows of three each, the viaduct piers are in single rows of three in each. Two girders, of uniform depth throughout, carry each line of rails, those above the roadway are perfectly distinct and do not depend upon each other. 50 feet above the large span a circular tube 9 feet diameter is placed, from which the roadway to each is suspended. This is done by two vertical frames of wrought iron, dividing the girder into three spaces, the centre the widest, the spaces braced with cross chains put together in links similar to suspension bars. The main chains hang from the tube at the ends over the pier to the opposite corner at the level of the roadway, where they are joined across the centre on both sides of the girder, and the middle space is crossed by chains both ways, which give additional security to the centre of the girder. The tubes are carried at each end on seventeen rollers, 5″ diameter, which allow for expansion and contraction;

the diameter of the pins which carry the leading chains is 7 inches. The girders are formed of single wrought plates, with top angular casing 3 feet wide, and a curved bottom flange. This girder is made strong enough for the 100 feet spans; and over the space three times that width, it will be perceived that it is supported in two intermediate parts, so that in reality the girder has very nearly the same bearing throughout. This is an extremely ingenious arrangement, the sectional quantity of material used with reference to the span being less than in any like structure. But it is to be regretted that from its want of symmetry and its lop-sided appearance, it is by no means an agreeable design. The *Great Saltash Bridge* is on the same principle, with four spans, the two principal not less than 445 feet.

The objection to combination girders does not apply to those made all of wrought iron. In cast iron the girder is broken by the first deflection, but no mischief is done to wrought before the trussing bars or suspension rods are called into action.

The *Boyne Bridge*, on the Dublin and Belfast Railway, is one of the finest examples of the *lattice girder* which has hitherto been executed. The main span is 264 feet between the bearings, the two side spans 137 feet. At the end next the town of Drogheda are thirteen arches of masonry of semicircular form, 61 feet span, at the other end are three similar ones. These are built of finely wrought stone. The height of the bridge above water mark is 100 feet, allowing the passage of shipping without striking top gallant masts. The depth of the lattice girder is $22\frac{1}{2}$ feet. It is formed of top and bottom wrought tubular chords, the area of the top chord where the greatest strength is required is 265 inches, where the least, 137, the lattices are placed on each side of the chord at an angle of 45°, 7 feet 6 apart, forming double squares in height, the sizes vary from 10″ by $\frac{5}{8}$ to 4″ by $\frac{3}{8}$ according to the strains; they are closely bolted to cross braces at the intersections. There is a double line of railway, with the girders on the outside, measuring 24 feet 6 in the clear; the roadway is supported on cross beams also on the lattice principle 7 feet 6 apart, covered with 6 inch planking bolted down. The girders being joined over the piers form one length, and are fixed only on one pier, the other supports being the usual rollers working in grooves to admit of expansion. Sir J. M'Neil was Chief Engineer; Mr. Burdon and Mr. Barton (to the latter of whom I am indebted for much information on the subject) were the Resident Engineers.

It will be perceived that the principle of the lattice girder does not materially differ from that of the large tube, the sides of the former being open with lattices where material is not so much required. With the same weight of metal the lattice girders will carry a greater load than tubes. The comparative duration has not yet been ascertained, but the lightness and elegance of appearance and several other considerations are greatly in favour of the lattice bridge. For further particulars useful reference may be made to notes of the comparative strength of the tube, Warrens', and the lattice girder, by Mr. James Barton, C.E. Various opinions have been also given by eminent Engineers which will be found in the Transactions of the Institute of Civil Engineers.

In forming a comparison of the materials to be used for any particular work, whether a bridge or a viaduct, many questions have to be taken into consideration, but none more important than that of economy. To arrive at that, the original outlay and the probable durability must be taken into consideration; and from what has hitherto taken place the conclusion arrived at appears to be in favour of wrought iron; but it should also be noticed that metals can be destroyed by repeated vibrations, which have a tendency to separate the particles of which they are composed. As a sufficient excess of strength, should be provided, this objection does not detract from the value of the material, while it demands additional skill and ingenuity on the part of the constructor.

Stone and Brick Viaducts.

	Height. feet.	Span. feet.	Length. yards.
Sunderland - -	130	160	200
Langollen - -	145	90	550
Rhymney - -	140	40	400
Congleton - -	114	50	350
Ouse Valley -	110	45	480
Folkestone - -	100	30	200
Stockport - -	100	60	600

Timber Viaducts.

	Height.	Span.	Length.
Dinting - -	120	125	200
Landore - -	109	90	600
Scotswood - -	—	60	350

American Timber Viaducts.

Portsmouth River -	—	250	—
Columbia - -	—	200	2200
Cumberland - -	—	175	1400
Portage - -	230	50	250

Iron Viaducts and Bridges.

	Height.	Span.	Length.
Crumlin - -	200	150	550
Sitter - -	200	137	200
Britannia - -	120	460	500

Iron Viaducts and Bridges—continued.

	Height. feet.	Span. feet.	Length. yards.
High Level - -	120	125	250
Chepstow - -	120	290	250
Boyne - -	120	260	350
Saltash - -	120	445	450

Stone and Brick Bridges.

	Span.	Rise.	Date.
Chester - -	200	42	1833
London - -	152	30	1831
Gloster - -	150	35	1827
Ponty Prydd -	140	35	1755
Maidenhead -	128	24	1835
Neuilly - -	127	35	1774
Waterloo - -	120	38	1816

Suspension Bridges.

	Span.
Niagara, Queenstown	1040
Wheeling - -	1010
Freyburg - -	820
Niagara, at the Falls	760
Pesth - -	678
Hungerford, London	676
Menai - -	580

Mr. G. R. Burnell, Visitor, observed that Mr. Clayton had hardly given a sufficient account of the practice of modern days, especially with respect to the works constructed of brick and stone. He had omitted altogether a most extraordinary series of works lately executed on the railways of Saxony. Amongst this class of works was also the aqueduct of Roque Faveur, near Marseilles, the length of which was upwards of 1300 feet, and the greatest height 280 feet from the valley beneath. On the Saxon railways the height of the principal pier of one viaduct was 302 feet, the total length of the viaduct being above 1900 feet. It was almost entirely of brick, the span of the larger arches being about 96 feet. Mr. Clayton stated that the original application of cast iron on the voussoir principle, hardly extended beyond a span of 100 feet; whereas a Report to Parliament in 1808, contained a design, by Telford, for London Bridge upon that principle, in one span of above 600 feet. With regard to timber bridges, he (Mr. Burnell) had designed some of bent timber ribs, with a span of 140 feet, and had followed out the execution of them, but in five or six years they had failed, from the continual vibration opening the joints, and allowing the moisture to penetrate. With respect to timber viaducts, there were several in the United States of larger dimensions than those mentioned by Mr. Clayton. He had seen some of 240 feet span, and near Philadelphia there were some even larger. Timber Lattice Bridges were objectionable because the timber was sure to warp. The Parliamentary Commissioners were therefore right in opposing the lattice principle in timber, but not in objecting to it in wrought iron. Its application in wrought iron bridges of large span would form an interesting subject for discussion. The ultimate durability of wrought iron bridges was still a doubtful point, and indeed, foreign engineers appeared to be giving up the application of that material, and to have employed cast iron on the voussoir principle on the railways recently finished in France for bridges of 160 and 170 feet span. As to compound girder bridges, he thought their failure did not so much arise

from the unequal contraction and expansion of cast and wrought iron, as from the suspension bar having no support independent of the girder itself; so that if the latter failed anywhere the wrought iron truss must fail with it. Thus a good principle might have been laid aside because attention had not been called to a defect in its first application. The aqueduct at Spoleto, in Italy, deserved more notice. It was said to be of the time of Theodoric, but he did not think it could be so ancient. For height and boldness it would bear comparison with any modern viaduct. In the Crumlin Viaduct, he considered it philosophically wrong to make the girder of the same depth throughout. The form of the girder of the Ouse Bridge was far more logical.

Mr. Clayton stated that he had given the average dimensions of the metal; the girders were slightly curved, and all the proportions had been carefully calculated to answer their intended purpose.

Mr. C. Barry, Fellow, said, that instead of blaming Mr. Clayton for not referring to more numerous instances, he felt that he had almost overwhelmed them with matter for discussion. No doubt if the subject were to be entirely opened, many structures of a like kind would occur to gentlemen present, and to Mr. Clayton himself. With regard to the Crumlin Viaduct he had understood Mr. Clayton that the lofty piers or bearings were made of a series of stages of columns braced together, but all of one thickness of metal from bottom to top.

Mr. Clayton explained that the core was a little altered, so that there was a larger section of metal below than above.

Mr. M. D. Wyatt, Hon. Sec., stated that he saw the beam directly after the test weight was taken off, and it had not sustained the slightest injury. There had never been a work of the same kind executed, in which the preparation of the necessary variety of patterns, or the immense number of different pieces, was so great as in this instance.

Mr. Clayton, in answer to a question, explained that the columns were inclined from bottom to top throughout. The bearing of the base was inclined, but all the other joints were at right angles with the axis of the columns.

Mr. Donaldson, H.S.F.C., said it had always been the principle of the Institute to accept with gratitude any information afforded in the papers read, whether complete or incomplete, and not in any way to question its extent, or to suggest that the author should have extended his researches in order to render it more comprehensive. For himself he had derived much information from Mr. Clayton's paper. It was exceedingly interesting to note the ingenuity of modern engineers in endeavouring to accomplish the objects of strength, capacity, and economy.* He had not risen, however, to enter into any of the interesting questions raised by the paper, but to vindicate the Institute, by expressing its thanks for the information thus brought forward. Of course they would be equally thankful for additional or supplementary information from any other gentleman. He begged to move the best thanks of the Institute to Mr. Clayton.

Mr. G. R. Burnell disclaimed any intention of finding fault with the paper. He wished simply to call attention to some important works which had not been noticed.

The Chairman (Mr. Bunning, V.P.), in putting the motion, which was carried unanimously, observed that it was impossible in one paper to notice all the great bridges and viaducts of the last few years. He hoped Mr. Burnell would favour the Institute with a paper illustrating the examples he had referred to.

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* The famous bridge over the Danube, built by Trajan, consisted of 20 piers of squared marble, 150 feet high, 60 feet wide, 170 feet apart, surmounted by framed wood work, which formed the roadway. Illustrations of this bridge exist on the Trajan column at Rome, and are engraved by Bartoli.

ADDENDA.

Messrs. Kennard are now constructing some girders for bridges on an Indian railway, on the half lattice or Warren principle, with a reverse bearing to those of the Crumlin Viaduct. The upper beam is cased, and the bottom tie is formed of bars much in the same way, but the support being altogether under the whole girder, the ties and struts are changed, and the last strut runs on to the bearing on the piers. The girders are 90 feet long and 7 feet deep, and are placed 14 feet apart. The roadway is sustained just above the bottom tie by suspending plates from the upper beam, which are also connected below and made to act as vertical ties to the whole. There are thirteen diagonals in each direction, and the pins connecting them differ in size according to the strain; the largest being connected with the bottom tie. They vary in diameter from 4″ to $2\frac{1}{2}$″ from the ends towards the centre, and those to the upper beam from 3 to 2 inches in the same direction. The number of bars in the bottom tie increases from two to eight, which are very nearly of the same thickness.

ERRATA (in paper of April 28, 1856) line 19, page 132. "Mr. Papworth observed that the principle of the beam had been approved (NOT APPLIED) by the late Mr. Thomas Cubitt for a roof of 100 feet span."

ON THE DOMESTIC BUILDINGS OF WESTERN FLANDERS IN THE SIXTEENTH CENTURY, ILLUSTRATING THE ORNAMENTAL BRICK-WORK OF THAT PERIOD.

By R. D. Chantrell, Fellow.

Read at the Ordinary General Meeting of the Royal Institute of British Architects, June 2nd, 1856.

Belgium, for the last twenty-five years only an independent kingdom, had previously undergone as many changes as it contains provinces under Austria, Spain, Holland, and France, and was at the commencement of the present century subdivided under the last named power into departments named from the rivers or other local features. It is now, however, restored to its former Flemish counties, Brabant in the centre, containing the seat of royalty, Brussels, with Antwerp, celebrated for its fine cathedral, East Flanders with its capital, Ghent, the birth-place of our John of Gaunt, and West Flanders with its chief town Bruges.

On the east and south the provinces of Limburg, Liege, Namur, Luxemburg, and Hainault, all more or less mountainous districts, offer in their products of coal, iron, stone, marble, clay, and timber, nearly all the materials required for building.

West Flanders was once the most important province from its long line of sea board, with the ports of Dunkirk, Furnes, Nieuport, Ostend, Sluys, and Damme. The last, now a mere farming village with a population under nine hundred, was once a strongly fortified town containing more than 25,000 inhabitants, who early in the thirteenth century destroyed a fleet of 1,200 ships sent against them by Philippe Auguste, King of France, in the Bay of the Zwyn, which has now been long warped up, the sea having receded nearly six miles. The French shortly after burnt the town, but in 1384, it was so strongly fortified that it resisted for a considerable time an army of 80,000 men, and was forced to capitulate only from the want of fresh water. Its grassy ramparts still indicate the site of massive brick bastions and extensive lines of fortification, while its name denotes that like Ostend, Furnes, and Nieuport, the besieged could innundate the surrounding country so long as they held the dam or flood-gates, and that there was a dam to retain the supply of fresh water which was conveyed to them by the Bruges canal.

The whole surface of the country towards the north is covered with loose, light sand, and clays and marls are only found in the east and south at some depth below it; so that brick, lime, and stone are obtained from a distance by means of the canals with which the country is intersected, although railways now traverse a large district and must soon tend to expedite the traffic. All the western province is low and level, like Holland, and only needs locks to pen up the water to float their inland vessels or canal boats, whilst portions of the dykes may be under repair.

Above the trees lining the canals and roads are seen some few of the plain brick towers of the village churches with their high pitched moss-grown tiled roofs, their apses and their crosses. On the canal from Bruges to Sluys the first is the fine old thirteenth-century brick tower of the Church of Damme, which is over 150 feet in height. The nave, side aisles, and transepts were destroyed at the close of the last century by the French Revolutionists, by whom the churches were either converted into "Temples of Reason," or used as Cavalry Stables; the bells were coined into money stamped with the cap of liberty, and the fine painted glass was removed from the windows and sold in some instances to London glaziers, who retailed it at their own prices.

The nave of this church did not exceed 80 feet in length, but the choir, now reinstated as the

village church, is more than 100 feet in extent from the eastern face of the transept to the spring of the apse of the high altar, and 36 feet wide in the clear; the aisles of 28 feet each, and the clustered pillars of 5 feet each, give more than 100 feet total width. These dimensions as well as the height are nearly the same as what remains of the nave of the fine old Priory Church, now used by the Dutch Protestants, in Austin Friars, London.

The windows have moulded bricks externally, but within, the capitals, bases, column shafts, piers, pillars, string courses and mouldings, are of a hard blue lime stone from Ecaussines, in Hainault, near to Nivelles in Brabant.

In most parts of Belgium this hard blue stone (somewhat akin to our blue or black mountain limestone from Skipton, in Craven, West Yorkshire), by the French named "Pierre d'Ecaussines," and by the Belgians "Orduyn Steen," is used for decorative purposes only, the cost of working almost preventing its common use. A stone, somewhat similar in appearance but softer, is obtained from the Weald formation near Tournai, in Hainault; it is known as Tournai stone, and is sometimes used for building, but generally for paving. It bears some resemblance to our Kentish Rag but it is rather darker in colour.

The Town Hall or "Stadt Huys," at Damme, is partly faced with it, the pinnacles, steps, brackets, and other ornaments are of the Ecaussines stone, but the end and back wall sare of brick; the vaulting of the basement, once the guard-house, now a stable, has the pillars, arch and groin ribs of stone filled in with brick. This building is now used as an "Estaminet," or tavern. Internally, some of the rooms have plastered walls, but others are bare; all the large floor beams are of oak, richly carved, and the joists and boards are of the same wood; in one of the rooms is a plastered ceiling of the last century; the walls are generally lined with oak panneling to a considerable height, and some of the "Arras," or tapestry remains above it.

Advancing eastward on the canal we see the church towers of Oostkerke, Houcke, Lissweghe, West Capelle, and others, which point out the locality of the several villages; the Church of Damme being the type of the whole of the churches, but of more importance.

On the east side of the road to Blankenberg all the churches have towers, while on the west, even to the frontier of France, they have all variously formed spires.

On the right of the Town Hall, at Damme, is the ornamented brick house belonging to the Burgomaster, the farm buildings are on each side; over the entrance door is an ornament carved in white stone (like that of Paris) from beneath the clay of Dieghem and Martélanche. At Iseghem on the line of railway between Bruges and Courtrai the church is in course of re-construction entirely with this stone. The rest of this house is built wholly with brick, and the roof is covered with pantiles; the front has piers corbelled out on the lower story which terminate with arches above, and form recesses moulded with a bead and hollow, the former describing the jamb and arch and the latter the tracery; the tracery forms a second hollow, and the wall within the recesses recovers its face by the projection of the window cills. In the further portion or mass of this house, which contains the entrance door, the piers rise from the base, and the recesses are plain, though the mouldings are the same as in the traceried portion.

The bricks are similar in dimensions to those of this country, but there is a small compact red brick called by the natives "Brabant Steen," resembling the old Roman brick in quality, and which, set in Dutch tarras, makes very sound work. In some of the oldest buildings a large brick has been used, of ordinary proportions, but one-third larger; it may be seen in the churches, town halls, and gates. It is made of unmixed clay and remains very perfect.

On entering the town of Bruges we are reminded of the olden times by its gates, which are

closed at nine o'clock every night. The old Ghent gate will convey an idea of those remaining, viz., the Porte Marechale, St^e. Croix, and d'Ostende; those of Bouvine, St^e. Catherine and St. Laurent or Dammo, having been rebuilt or modernized. The fortifications have long been dismantled, but the broad moat still surrounds the ramparts and a second moat outside, but not so broad as the first, shows that the town was well calculated for a long and formidable resistance to besiegers. The buildings have an uniform yellow tint, which arises from a regulation of the Municipality long in force, and gives a very cleanly aspect to the place, the yellow washing being required annually. In the earlier years of this century contrast was the fashion, and every one compelled to colour the front of his house chose the most opposite colour to his neighbour, as red, pink, blue, green, &c. The yellow colour predominant in the several illustrations will thus be accounted for; whether this originated in the large villages of Gheluwe (yellow) and Ghelu veld (yellow field) I cannot say, but a few years ago on my way from Courtrai to Ypres, I first noticed in both these places that all the buildings were yellow washed even to the churches.

I have selected a few of the most striking brick house façades in Bruges, where the high roofs terminate in picturesque gables, ornamented with arches and tracery. There are as many of them with plain copings as with steps, though these stepped roofs have always been considered essentially Belgian. The old chimney stacks were ornamented and invariably covered over to check the eddy or down draft occasioned by the lofty roofs, and though few remain intact, it is found necessary to cover the flues, so that a most curious amalgamation of ridge tiles is seen crowning the chimney stacks in every part of the town. Wood is invariably burnt by the inhabitants upon the hearth, rested upon a piece of iron called a dog, as coal is of comparatively recent introduction by the English residents; the flues are smaller than ours, and are usually cleansed about once a year by an iron ball attached to a rope and a bundle of straw at the other end. Sometimes two dogs or "fire irons" were placed on the fire brick hearth for the small bundles of wood or faggots, and were highly ornamented with figures and devices very creditable to the skill of the smiths. The large open fire-places have usually a large slab of Ecaussines stone, moulded, on each side, and a deep mantel which projects considerably, and the chimney breast above it is highly ornamented. Many of those from the town halls of Bruges, Courtrai, Oudenaerde, and other places, are most elaborately carved, and have been made known to us by the accurate drawings of Mr. Louis Haghe. The inside under the lofty mantel is frequently lined with white Dutch tiles, which give a light and cheerful effect. In ordinary houses, the white and blue figured tiles with grotesque ships, windmills, and landscapes, give a far more pleasing aspect than the blackened cast iron contrivances, which convey the heat up the chimney and radiate but little into the apartment of an English house. Now occasionally the fire-places are closed and stoves placed in front. Our kitchen fire-place is rarely seen in Belgium, the cooking being performed on open "Carréfours" or square furnaces, with charcoal, or rather the wood ashes from the bakers' ovens.

In many of the streets groups of buildings remain unchanged, and the Rue Queue de Vache affords one of the best specimens of street architecture, having decorated houses on each side. The date, 1561, upon one corner building, is formed by iron bolts or bars bolted through to the beams, which rest upon the solid front piers, and act as main ties to the floors, roofs, and walls,—these irons, which are called by the Flemmings "Ankers" (Anchors), may be observed in all the old houses. The large oak beams and joists, having always been exposed, are as sound as when first placed. The beams usually extend from the front to the back wall, crossing the brick partitions; the joists are either laid upon or dovetailed into the beams, flush with the upper side, and the floor boards are pinned or trenailed to them. In the better houses parqueterie is laid over rough boards, but all are kept polished, as carpets are luxuries till recently scarcely known to the Belgians.

The streets are paved with large pebbles or shingle from the sea shore; they incline from the houses to the middle, where a channel or gutter is formed, and a side footpath is scarcely seen, except of recent date; the water from these middle street channels is conveyed by shoots into the numerous canals, so that after a shower of rain the streets are soon clean and dry.

Sometimes before an entrance door a narrow paving with slabs of Tournai stone (each about a foot square) is found, which like our Rock Hill flag is slippery when worn and wetted. The floors of the entrance halls are also paved with small Tournai slabs; the wooden and brick floors are usually sanded.

In the adjoining street, "Rue des Aiguilles," is another picturesque brick building, formerly the town residence of the Counts de Saint Pol Tiennes, now the school for instructing poor girls in lace making, founded in 1816 by the Abbé Defoere.

In this building there is another feature said to have originated in Bruges—the staircase turret carried frequently to a considerable height for the purpose of an observatory. Mons. Delepierre, Belgian Consul in London, a learned antiquary, states that the foreign consuls and merchants had them erected that they might witness the arrival and departure of their ships. The lower part is of brick, and the foliated gallery and crocketted spire of white Dieghem stone. There are varieties of them in the town, for though numerous, no two are alike. The salient angle turret is another peculiar feature of Belgian buildings, both in town and country; some of very remote antiquity are circular on plan, the angular forms being later, both hexagonal, octagonal, and multangular. Sometimes they are corbelled over with plain or moulded bricks, and occasionally they spring from large, richly carved stone brackets.

Nearly opposite to this, in the "Rue des Tonneliers," is another lofty house with arched and traceried recesses, terminated with a square screen or "*masque*," raised only in the centre to take the bolt of the ridge piece of the roof. This, with the lower portion adjoining and the further gabled building, formed one large house, with a court yard in the centre. The basement and gateway jambs and arch are of Ecaussines stone, the rest of old red brick. The rooms of this and most of the large houses of this time are at least 15 feet in height; they were erected when Bruges was the emporium of commerce, and its prince merchants were of the class of Shakespeare's Antonio.

They had their East India Company's House, with its lofty tower, now only hinted at by the adjacent "Tower Bridge," but shown on the old illustrated map by Marcus Gerardus, 1562, in the Town Hall; the Dukes of Burgundy and of Brabant, and the Counts of Flanders had their palaces of the "Seven Towers" on the Bourg adjoining the Town Hall, the Cathedral of St. Donat (the last remains were removed in 1805), and the Church of St. Basile; the Palace "Princen hof," or Court of Princes, and the Mint were near together. The house in the Rue des Tonneliers was once occupied by King Charles the Second of England when in exile. He then patronized the Society of Archers of Saint Sebastian, and on his restoration gave them his portrait and some valuable presents, which still decorate their ancient hall.

The population of Bruges was then over 200,000, but now it is not one fourth of that number; and from its frequent sieges, and the destruction of its cathedral and many churches and religious houses towards the close of the last century, gardens of great extent are attached to many houses in the town. Two other square fronted houses of later date are equally decorated, though differing in character. The basement is of stone up to the windows, the upper part of red brick moulded in the arches and jambs, and the ornaments are panelled, fretted, or reticulated, all of varied patterns. The parapet is embattled, and over each pier is a corbelled turret decorated like some of our Elizabethan chimney shafts: the upper parts have been destroyed. Over the arches are inserted white stone medallions.

This building, and another in the Rue Neuve opposite, are called the Spanish Houses; both are covered with terraces or lead flats, and have their beam "ankers" in the piers.

On this square stands the great belfry, or as it is now called "Tour de la Halle," built of brick in 1291. The quoins and some of the mouldings, the hexagonal pinnacles of the upper stage, the angles of the upper octagonal stage, the small windows, belfry jambs, and the arches are of stone; the masks or salient angles, and the body with the recesses and some of the tracery, are of brick.

Of the form of the original termination there is no account, but after being struck by lightning in 1492, it was decorated with a wooden bulbous formed composition, which was again destroyed by a storm in 1741. It was then covered with a common low pitched roof till 1824, when pinnacles and a parapet were added.

This tower was at first insulated, but in 1364 the large hall surrounding it was built by the cloth merchants for their market house, in which the annual fairs are now held. The tower is about 300 feet in height, and with that of the Church of Notre Dame, 360 feet high, may be seen from the sea on approaching the Port of Ostend. The belfry contains four octaves of bells, varying from 23,000 to 28lbs. in weight. The apertures are open, and the bells visible; they are firmly attached by the head to oak frames, and are struck on the external surface by hammers connected with levers balanced by weights, and raised by strong wires also acted upon by metal pegs inserted in a large copper cylinder, turned by a weight which is wound up daily. Four airs are set upon the cylinder, one for each quarter of an hour; these are generally changed once in three years. On Wednesdays, Saturdays, and Sundays, from noon till one o'clock, modern airs are played on the bells by a professor of music, who strikes keys properly balanced. These chimes or carillons, which are said to be the finest in the world, were invented in 1469 by a native of Alost, near Gand, and first introduced in this tower in 1503 by Simon Waeghenlis, of Mechlin. The bells were recast in 1675 by Melchior de Haese, of Antwerp, and again after the fire in 1741 by Georges and Jaques Dumery. They remain in very perfect condition, though exposed for more than a century to the action of the weather. In 1805, when preparations were being made for a descent on England, being a detenu in the town, I could see with a telescope our English blockading squadron from this belfry.

Crossing the Grande Place to the Rue Flammande, I have selected from the numerous brick buildings a curious front, rising from a central pillar and corbels which project two feet from the end walls; all is brick excepting the pillar shaft, brackets, key-stones of the arches below, and the huge crockets and ornaments on the coping of the gable, which are of Ecaussines stone. Continuing by the Quai des Augustins, and passing several of the same class of houses, at the corner of the Rue Espagnole, is a double-gabled house bearing the date 1596 in front, and on the Quai de la Main d'or adjoining (on the site of the India House and doubtless a portion of it), is a building with the corners bevelled off for brackets and canopies to contain statues of saints, many of which have been re-instated; the recesses are richly moulded and contain pillar bases, but the roof has been recently modernized, the gables, arches and tracery removed, and a wooden cornice substituted. This will give an idea of the general style of modernization now in progress. Opposite this building are two very singular gables; the recesses are moulded and contain pillars with capitals and bases. Leaving these buildings by the Place des Orientaux (now Wednesday Market), we arrive at the Place de l'Academie. The Academy of Arts is a doubtful restoration of the fourteenth century hall burnt 1755, but near to it is the sixteenth century Weigh-house, for regulating the towns dues, or "Octroi." The steps, columns, arches and tracery, with the curious recessed window, are of stone, but the warehouse portion of the building is of brick; within sight of this building are nearly a dozen others of the same class, and the old Exchange is a fine specimen of a hall of the fourteenth century. On the "Quai-

long," bordering the canal, which passes through the town and unites those of Gand and Ostend, is another good example of this class of houses. In St. John's Street among several others, one is selected for the curious line of junction of the arches; and in the Rue des Pierres we find a very lofty gable covering five apertures in width. At the back of the "Palais de Justice," communicating with the old Corporation Hall, or "Maison des Francs," which contains the celebrated carved chimney-piece in stone, marble, and oak, is a curiously ornamented brick gable, so situated that it can only be seen from a private garden, from which an arch leads to a vaulted basement under the hall, the front of which, with curious angle turrets springing from corbels, faces the canal of the Fish Market. The high pitched roofs are covered both with pan and plain tiles. Most of the roofs are lighted by glass tiles of the same form and thickness as those of clay; they have been used for ages as well as the conical ventilators which are made to fit to both plain and pantiles. The general character of the buildings is not confined to the vicinity of Bruges, for there were many of the towns proportionately opulent which are now equally reduced. All these houses were most substantially built; both the external and partition walls were of great thickness; the cellars invariably vaulted, the arches in many instances formed of accurately radiated stone and hard burnt bricks, usually set in tarras; in many of these houses plaster was entirely omitted, the walls being lined from the floor with panelled oak wainscoating or dado upon battens over trellis, upon which strong canvas was nailed, which was covered with stamped, gilded, and coloured leather, often tapestry, and even oil paintings. The floor beams were frequently carved on the underside. In the tapestried rooms, jib doors, with concealed hinges and spring latches, were well contrived so as not to interfere with the design. The windows (from their cross bars called croisées) are of considerable antiquity, and in many cases coeval with the buildings; they open on hinges both outwards and inwards, and sometimes slide and fasten by side bolts or iron pins. Sash windows are unknown.

In the fine old fortified frontier town of Ypres (now in course of dismantling) which contains but a tithe of its former population, the same general style of domestic architecture prevails. I was struck with the fine proportions of a lofty house built entirely with Ecuassines stone, and on enquiry ascertained that it was called "La Maison des Templiers," being a portion of the buildings belonging to the Knights Templars, erected in 1250. The remains of the corbelled turret are hexagonal on plan, and the tracery of the upper windows varies. This town contains a magnificent town hall of the 14th century, 430 feet long in front, with a large corbelled pinnacle at each end, and a grand central tower with corbelled pinnacles at each angle and a spire. The brick Church of St. Peter has corbelled, polygonal turrets at the angles of the transition Norman tower, and curious square projections on each side for staircases which rise from the ground. The body of the church, rebuilt with brick in the fourteenth century, is 250 feet long and 90 feet wide.

The Cathedral of St. Martin is a fine thirteenth century structure, with transepts and a grand western tower; a spire begun at the end of the fourteenth century is still incomplete, and some of the angle crockets remain within an enclosure on the north side as they were left by the workmen. Another fine (fifteenth century) church is St. Jacques', and there are several monastic buildings of later date. The towns of Commines, Wervick, Menin, Courtrai, Roulers, and Thourout, with many others, contain large brick churches, and their brick buildings present the same general features as those of the capital, Bruges.

Now, inferior brickwork and stucco are coming into fashion and superseding the fine old realities; on the Quai Saint Walburge, in Bruges, I recently observed that a large old building, used for many years as a cavalry barrack, was being prepared for the Athenée or public school of the town. The basement appeared to be of granite, but on approaching to ascertain whether it was granite or Ecaus-

sines stone, I was surprised to find it only one inch thick, a mere plaster imitation; this too a public work conducted by l'Architecte do la Ville!

All modern buildings are of the same character; plaster fronts, wood or plaster cornices, are rapidly superseding the old gabled realities, and compo is there as here the genius of the age; plaster and paint imitating whatever modern taste, or the want of it, requires.

All these old buildings in their picturesque variety, with sufficient light and shade, required not the aid of colour to improve them, and the Spanish as well as the Gothic traceried elevations might suggest an idea for improving the style of decoration in our street architecture without having recourse to mere copyism. Brick, no longer subjected to an excise duty, might be moulded to any form required by the architect, arches, semicircular or segmental, thrown over apertures unlimited in extent, and window openings made of adequate size for the admission of light and air, with every comfort that the most sanitary measures could demand; ornament might also be introduced in a similar manner, and skylines formed of great variety with brick (when the expense of stone precluded its use), properly set in cement, which ought to be capable of resisting the effects of rain, so that we might have dry and durable houses. The great difficulty arises not from want of skill or good materials, but from the admixture of inferior and improper ones by the speculating builder, who, though he professes to build cheaper than the architect, will ultimately prove more expensive to the unfortunate owner, who is deceived by the flimsy cloak that for a time covers the rottenness beneath it.

The Chairman (Mr. G. G. Scott, V.P.) in requesting from the Members remarks or inquiries in further elucidation of the subject, called attention to the elaborate manner in which the MS. of Mr. Chantrell's Essay was illustrated with a series of excellent sketches, which Mr. Chantrell had kindly presented to the Institute. The Chairman proceeded to observe with regret that the great towns of Belgium had sunk from their former commercial importance into comparative decay, and that "compo" was every day detracting from their architectural interest. It would be most desirable to have the ancient buildings of Belgium fully illustrated by measured drawings; for street architecture these buildings furnished a most valuable field of study. The brick buildings of Italy and North Germany were better known than those of Belgium, probably because the latter were in remote towns at a distance from the main lines of railway. Thus, from Calais to Ypres, all the little towns were full of beautiful specimens of brickwork, both in the churches and houses. He might say that there were four great brick districts in Europe—1. some parts of England, particularly Norfolk; 2. Belgium; 3. the North of Germany; and 4. the North of Italy; each of them deserving of attentive study. There were also three sizes of ordinary bricks. The size now used for ordinary commercial purposes, being that which could be most easily handled and laid, would always prevail, but there were two other sizes. In the north of Germany they had not only a brick of our own ordinary size, and one about 7 or 8 inches long by $1\frac{1}{2}$ inch thick, but also an enormous brick used for buildings on a magnificent scale, being more than a foot long, $3\frac{1}{2}$ inches thick, and 6 inches wide. These were used with great effect in churches, city gates, &c. With regard to brick bond, the Chairman observed that at Richborough Castle bricks were used at certain intervals to bond together with flint rubble, over the face of which they were in some cases made to turn down. As the restrictive duty on bricks had been removed, it seemed absurd that architects should have gone on for four or five years without any application (except in a very few instances) of moulded bricks to ornamental uses. The misfortune was that they never prepared their working drawings long enough beforehand to give time for making moulded bricks. A great deal might easily be done not only with moulded but with cut bricks, of which

some beautiful specimens might be found in the 16th century buildings about London. Bricks fit for this purpose could be obtained not far from the metropolis, at Hedgerley and Chalfont. The moulded bricks on the Continent were often glazed with a green or black glaze, which gave them a very rich effect. At Lille there were some bricks with a bright green and a bright yellow glaze.

Mr. Chantrell said that glazed bricks were also used at Tournay and other places in Belgium, near the frontiers of France. They were still made at Rupelmonde, a great place for the manufacture of bricks, near Malines.

Mr. M. D. Wyatt, Hon. Sec., in reference to the manufacture of glazed bricks, said that the difficulty appeared to be to find a glaze which would expand and contract in the same ratio as the brick itself.

The Chairman said that it was the custom in Belgium to make bricks extremely rough, and to shape them afterwards with an axe; and Mr. Chantrell stated that this practice had been handed down from a very early date.

Mr. Jennings, Fellow, with reference to the English cut bricks of the 16th and 17th centuries, observed that they were all kiln burnt. Modern bricks were very unequally burnt, and besides the inferiority of the material, it would be more expensive to cut them for ornamental work than to employ stone. He referred to some beautiful cut brick capitals, about 200 years old, where it was evident the bricks had been built up first and cut afterwards. There would be no difficulty in getting bricks of any form or size if the demand for them existed, but brickmakers justly complained that they would not be able to get rid of any new forms or sizes.

Mr. Pocock, Fellow, concurred in the opinion that the adoption of moulded bricks depended entirely upon the time necessary for making them, and not on the extra expense. He knew a case occurring within the last few days, in which a gentleman had been obliged to abandon the use of a particular form of brick which he particularly desired, because he was told that it would take six weeks or two months to make them. Unless architects allowed the necessary time, there was not much chance of moulded bricks coming into use again. Mr. Pocock added that the rosettes in the metopes and the mouldings of the well known house in St. Martin's Lane, had been cut after the bricks were laid.

Mr. Donaldson, Hon. Sec. for Foreign Correspondence, remarked upon the singular fact that in the Belgian works the tracery was generally placed in the solid panels, and not, as in England, in the heads of the door and window openings. It would be very interesting to know exactly the manner in which this brickwork was put together, and particularly whether two or three originally types only were employed, and applied in different ways, as in the Moorish style, or whether the bricks were put up in rectangular forms and cut afterwards. He hoped Mr. Chantrell would investigate this point during his next annual visit to Belgium. Before moulded bricks could be successfully employed in England, it would be necessary to train a class of workmen for the use of them. With regard to the Belgian buildings it was a matter of regret that the high pitched roofs and other picturesque features had in many cases disappeared, and also that the fine brick work was disfigured and concealed by white and yellow wash. The smith's work of Belgium, briefly referred to by Mr. Chantrell, was of great excellence, and had been ably illustrated in the works of Mr. Haghe and Mr. Digby Wyatt. Mr. Chantrell had referred to the Spanish Houses of Bruges, and it was a curious circumstance that although the Spanish dominion in Flanders existed only 150 years, the buildings of that era, both in Bruges, Lille, and other towns, displayed a distinctive and magnificent Renaissance character, with large bold features and richness of decoration. He did not think the white stone employed at Bruges resembled that of Paris, but that it was rather an indurated chalk such as was

found at St. Omer. While on the fronts of some of the Belgian houses the iron work bore the date, on these Spanish houses the year was sculptured in the stone panels, so that a chronological series of them might be selected.

Mr. Papworth, Fellow, said that the English moulded and cut bricks were of a very different material from those now in use. Some good specimens would be found in the doorways of the two Temples in London. They were kiln burnt, with a close grain, made without breeze, and were laid, not in mortar, but in lime cream, thinned to the greatest possible extent, and they were sometimes driven into their place with a mallet. The work was left out in bosses where necessary, and these were cut to the required form. After being worked with the chisel they had to be rubbed, so that an enormous amount of work was necessary, and a 13 inch capital would not cost less than £6. or £8. at the present time. He believed the comparison of cost between moulded bricks of common form and common Portland stone would be a little, but not very much, in favour of the latter. To the four brick districts already mentioned, he begged to add another, the south of Spain, where some very interesting works existed. The Spaniards also used terra cotta, and of this material there were some examples in England. These dated from before the Civil War, and preceded the use of sculptured brickwork, which came in after that period.

Mr. Scoles, Fellow, said that moulded bricks had been extensively used (for the tracery of windows, &c.) at Cossey Hall, Norfolk, the seat of Lord Stafford. These bricks were made upon the spot, and he believed that the damage from breakage in burning rendered them as expensive as stone. For plain splayed work, however, moulded bricks would be as cheap as common bricks.

Mr. C. Fowler, Associate, said that the subject of brick buildings was peculiarly interesting to him, as he had had special opportunities of studying the subject, and had brought before the notice of the Institute the brick architecture of the north of Germany. The specimens illustrated by Mr. Chantrell were all of later date than those, with the exception of the Bell Tower of Bruges. The description which Mr. Chantrell had given of Bruges forcibly reminded him of the German towns, especially of Lübeck, where the wide but grass grown streets, and the houses, either untenanted or applied to other than their original purposes, exactly tallied with Mr. Chantrell's account of Bruges. In the practical application of moulded bricks the most essential requisite was to design so that very few moulds only should be needed. The buildings in the north of Germany presented great variety in their appearance, but the different forms employed were really very few. With M. Chateauneuf he had spent a considerable time in studying these buildings. They had drawn every moulding they could find, and the result was that the variety arose chiefly from the combination. They had also visited the places where the bricks were manufactured, and where in some instances the manufacture had been carried on for centuries. The brick-fields of Lübeck, for instance, had been in constant operation since the erection of the cathedral, repairs and other works being constantly required. At Lübeck the works were conducted in a very primitive manner, but at Rathenau,* where the best bricks were manufactured for Berlin, the more modern processes were used. All the German bricks were kiln burnt and retained their form better than the English clamp bricks. He believed that glazed bricks were not used at a very early period. Glazed headers however, accidentally vitrified in the kiln, were employed, and the use of artificially glazed bricks ensued. The latter appeared to have been glazed by dipping them into some solution, and perhaps burning them afterwards, but the glaze was certainly not applied before the brick was burnt. Mr. Fowler stated that his father had employed moulded bricks to some extent for the circular headed windows of a large lunatic asylum,

* In the old Mark of Brandenburg.

without any extra cost beyond that of plain bricks, which, for such a purpose, would require to be axed and rubbed.

Mr. Hayward, Associate, stated that the tower of the Church of St. Botolph, Colchester, adjoining the ancient Priory, was full of the most elaborate moulded brickwork, the work of the proprietor of a large brick-yard near the town; and it afforded a most satisfactory proof of our ability to execute any work of the kind.

The Chairman drew attention to the grandeur of the buildings illustrated by Mr. Chantrell, arising from their magnitude and height; points which were not sufficiently attended to in English street architecture.

A vote of thanks to Mr. Chantrell was passed unanimously, and the meeting adjourned.

ON THE RESEMBLANCE BETWEEN MEDIÆVAL AND CLASSICAL ART, AS EXEMPLIFIED IN THE GLASS PAINTINGS OF THE 12TH AND 13TH CENTURIES.

By Charles Winston, Esq., Hon. Mem.

Read at the Ordinary General Meeting of the Royal Institute of British Architects, June 16th, 1856.

It may perhaps be recollected that on a former occasion,* whilst adverting to the harmonious agreement between ancient painted glass and ancient Gothic architecture, I alluded to the resemblance which the glass paintings, contemporaneous with the architecture of the latter part of the 12th century and early part of the 13th, bore to the antique; and thus I concluded, from their agreement with the architecture, that we might contrive to produce modern glass paintings equally in keeping with early Gothic architecture, and superior to the old ones as works of art, if, instead of merely copying these ancient remains, or perhaps barely correcting their bad drawing, we should strive to work up to those models of excellence which inspired the earliest Christian artists, and which have been admired, and, I will venture to say, will be admired so long as an appreciation of beauty shall continue to be a faculty of the human mind, although persons may occasionally be met with who seem to have been rendered insensible or indifferent to their merit by a too exclusive study of the Mediæval art. In the discussion which these remarks occasioned, the propriety of illustrating my views by means of a drawing was suggested, and I agreed to resume the subject whenever I was prepared with such a means of explanation. I have been prevented from fulfilling my promise earlier, but the delay is not to be regretted, since it has afforded me more time for consideration. Even now I would particularly guard myself against the supposition that the drawing produced pretends to be a perfect exponent of my views. To carry out those views as I desire would require far greater artistic power than I can command; and therefore I must request you to regard it not by any means as a finished design, but simply as an explanatory diagram.

The influence which classical antiquity exerted on the arts of the West, principally through Byzantium, has been repeatedly insisted upon, and illustrated by modern writers. In some instances we are almost able to see the very track by which such influence was transmitted; in others it is impossible to forbear ascribing much to the effect of local remains, the fruit of a Roman occupation; in either case it is difficult to discriminate between the work of native and foreign artists. Still, however, a common resemblance points to a common origin. A variety of causes may unite to render this resemblance more palpable on some occasions than on others. But the wider the experience, the more positive is the belief in the Byzantine or Greek character of Western art in the 12th and 13th centuries.

From this influence ancient glass paintings are not exempt. They are infected by it in the same degree as other specimens of pictorial art. I am sorry I cannot corroborate by documentary evidence the opinion I have formed from the appearance of the painted glass. When and where the art of painting upon glass was discovered is still a matter of conjecture. The testimony of the earliest writer, Theophilus, by itself only shews that, at the time he wrote, France was, *par excellence*, the country in which it was practised. He tells his readers, that they will find in his book "all the knowledge that Greece possesses in the kinds and mixtures of colours; Tuscany in inlaid works, and the various kinds of niello; Arabia in malleable, fusible, or chased work; Italy in the various kinds of

* See Proceedings of the Institute of British Architects, Session 1853-54, p. 21.

vases, and the carving, enriched with gold and silver, of gems and ivory; *France in the precious variety of windows;* and industrious Germany in the delicate workmanship of gold, silver, copper, iron, wood, and stones." The Abbé Texier indeed—the author to whom I have had the most resort, because his inquiries are the most germain to my own pursuits—considers it probable that the honour of the discovery is due to the Limoges school of artists;* and though his chief reason, the similarity of the process of enamelling to that of glass painting, of itself is entitled to little weight, especially if the opinion be correct that Germany shared with Limoges the manufacture of enamelled ware, the leaning of my mind, in the absence of any evidence to the contrary, is in favour of his opinion. Our not finding any specimens of painted glass earlier than the 12th century or the end of the 11th, and these nowhere except in France—so far, at least, as I am aware of—affords a presumption that earlier specimens never existed, and that the commencement of the manufacture was in France. And I have long been of opinion that the glass used in the earliest glass paintings was made from Greek or Byzantine recipes, on account of its being so similar in texture and colour to the ancient Greek glass. Therefore (without, however, necessarily committing ourselves to the opinion that the art was discovered in France) I think we may safely conclude that it was discovered in Western Europe by some school of artists under Byzantine influence. Indeed, the very badness of the figure-drawing in the earliest examples, as compared with the excellence of the foliaged ornaments—and which, therefore, cannot be attributed, as in the case of the earliest Enamels, to any peculiar difficulty in the manufacture—is an argument in favour of the discovery being made by a school of artists as yet immature, such as a provincial school might be considered in comparison with that of Byzantium. And by way of accounting for the spread and intensity of Byzantine influence in France, I may mention, on the authority of M. Texier, that as early as 979 a Venetian colony was settled at Limoges, for the purpose of trading with the spices and other commodities of the East, conveyed from Egypt by way of Marseilles. Mr. Fergusson, in his very useful Handbook,† corroborates the supposition that it was with Alexandria that the Venetians had their closest connexion, though no doubt, as the great carriers of the Levant, they were, at that time, in frequent communication with Byzantium. To what extent the Venetians imbibed the Byzantine principles of architecture—in some degree modified by their commerce with Alexandria—is seen by a reference to their great Church of St. Mark (a building remarkable, according to Mr. Fergusson, for being the only real specimen of Byzantine architecture within the limits of the Western empire), and the Churches of St. Front Périgueux, the erection of which is ascribed to the Doge Orscolo I., who came to sojourn in France in 978. Souillac, Angoulême, Cahors, Solignac, Fontevrault Abbey, Fleac, St. Hilary of Poictiers, and others, all at no great distance from Limoges, attest, in their general architectural resemblance to St. Mark's, how thoroughly the colony carried with it the taste and arts of the parent State.

The Byzantine school, thus implanted in France, was during a considerable period continually having its traditions revivified and corrected by the influx of fresh artists, and new works of art from the East. Greek artists, it seems, were living there in the 13th century; and as late as 1421 an inhabitant of Limoges brought with him an artist to carve a resemblance of the Holy Sepulchre, on his return, by way of Venice, from a pilgrimage to Jerusalem. If, then, glass painting were a French art, having its cradle in or in the neighbourhood of Limoges, we should expect to find its earliest remains displaying Byzantine features, and if so, the features more or less strongly developed of the

* See Essai historique et descriptif sur les Argentiers et les Émailleurs de Limoges, par M. l'Abbé Texier, Curé d'Auriat. Published in the Memoires of the "Societé des Antiquaires de l'ouest." 1841, 1842. Poictiers. 8vo.

† "The Illustrated Handbook of Architecture," by James Fergusson, M. R. I. B. A. 2 vols. Murray. 1855.

Antique; and wheresoever the birth-place of the art may have been, I assert that its earlier remains do display those features. The most careless observer can hardly fail to be struck with the resemblance between the glass paintings of and towards the middle of the 12th century, and the illuminations in the contemporary Greek MSS., or with the frequent recurrence in them of Greek ornaments; and the same general character may be traced in glass paintings until quite the middle of the second half of the 13th century, when it gradually died out, before the increasing influence of a new style, of which the sculptures in the choir of Lincoln, to which Mr. Cockerell has directed our attention,* may be said to be an early and a favourable type. But the glass paintings which, on the whole, most closely resemble the antique are these which were executed between 1170 and 1240, or thereabouts. I am not seeking to deny that these works were executed by native artists either in France or England, but I cannot ascribe, as some have done, their greater freedom and closer likeness to good models, merely to the progressive improvement of a school. It seems more reasonable to suppose that the change was in great measure caused by the influx of Greek artists, and greater aptitude on the part of their pupils to profit by instruction. The draperies, instead of being tightly wrapped about the limbs, and scanty in their proportions, as in the earlier examples, are more elegant and flowing, reminding one of the voluminous draperies of the antique; which they resemble not only in the set, but the very form of the folds, betokening a material thin in texture, and, from its pliancy, allowing the action of the limbs to be easily seen beneath it. The heads, too, more nearly resemble the antique in their contour. In one of the windows of Canterbury Cathedral, erected shortly after the fire in 1174 (the second window from the west, on the north aisle of the choir), are some heads which might have been copied from the old Roman. There are some similar ones at Lincoln, in glass, of the same date as that of the north rose, and now worked into it, though not belonging to it. There is also a strong resemblance to the antique in the fashion of the garments. It is well known that the Romans had in great measure ceased to be the gens togata (Romanos rerum dominos, gentemque togatam) even in the reign of the Emperor Augustus. The Lacerna, a cloak fastened on one shoulder with a clasp, and sometimes furnished with a hood, originally borrowed from the army, became, on account of its greater convenience, worn with the Tunic, as the ordinary dress of the Roman citizen, and by degrees the Toga was reserved for State occasions. After the removal of the seat of empire to Constantinople, a variety of additional dresses were used, many of them of Greek origin. The more stately of which were, with its usual tact, appropriated by the Church, as it gathered power, and which are the foundation of the Mass vestments of the Roman clergy at this day. This has been clearly demonstrated by the learned Krazer,† whose accuracy, though it may have been painful to the High Churchmen, as shewing the Pagan origin of some of the most sacred things, has never been impugned. Some of these dresses were, moreover, adopted in their courts by the barbarian conquerors of the Roman empire, and thus were handed down to later times. The Dalmatic, in which the effigy of King John in Worcester Cathedral is clothed, is an instance, and the modern Peers' State robe is another. The most popular dress amongst those nations who possessed themselves of the territories of the Empire, no doubt, was the Tunic, with or without the Lacerna, or a shorter cloak used by the private Legionaries, called the Sagum; and this dress, with slight modifications, appears to have been in actual use in the 13th century. The Mediævals almost invariably adopted the Tunic with long sleeves in preference to that with short sleeves, which was the one usually worn by the Romans; and instead of the Braccæ and buskins of antiquity, they clothed the nether man in long

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* Proceedings of the Archæological Institute at Lincoln. 1848.

† Krazer de Liturgiis. Augsburg. 1786.

hose, over which they used shoes or long boots. So that, with the exception of the legs and arms being clothed, there is but little difference between an ordinary 13th century figure copied from glass, and a figure taken from the arch of Titus, or Trajan's column. The long Tunic reaching to the feet, so common in the glass paintings of the 13th century, also had its prototype in Imperial Rome. The figures on the arch of Titus shew that it was at that time often worn beneath the Toga. Indeed, startling as it may appear, representations of the Toga itself are to be found in pictures on glass of the 13th century; and I have little doubt in my own mind that the mantle which, carelessly thrown over the long Tunic, constituted the conventional dress of prophets and of saints, not being ecclesiastics, throughout the middle ages—was, in fact, but a corruption of the Toga.

With regard to the Ornament, it is easy by means of the carved ivories, (of which I perceive a Catalogue by the Arundel Society has just been presented to this Institute) to trace the transition from the classical, to that used in the 12th and 13th centuries. It is so plain that the Mediæval artists borrowed their ideas of ornament from the antique, and which being so purely architectural and conventional is on that account I think the finest of all ornament, that I shall not urge the matter further. Indeed, the thing speaks for itself. I shall, therefore, proceed without further delay to deduce a few practical hints from the facts I have stated.

The question that naturally arises is—if glass paintings whose drawing so much resembles the antique, completely harmonize with the buildings of the 12th and 13th centuries; would not other glass paintings equally harmonize with such buildings, whose drawing should more exactly resemble the antique in point of excellence. I say in point of excellence, for I totally disclaim any intention of recommending the substitution of copies of Classical draperies or ornaments for Mediæval ones, or exchanging the individual character, and strictly human, as opposed to God-like, expression of the countenance which distinguish Christian art, for the more generalized and conventional treatment of the antique. I wish to see the Christian sentiment elevated but not obliterated by a study of the antique, and the Mediæval drapery drawn as the Mediæval artist would have drawn it had he possessed the power of the Greek.

I am persuaded that if the same tone of colour which we see in ancient glass paintings of the 12th and 13th centuries be adopted, all archæological requirements will be satisfied by adhering to the costume of the period, and general form of ornament, and preserving the individuality and character of the heads. Thus the attitudes of the figures, the arrangement of the groups, and general cast of the features, might be taken as closely as possible from the antique, whilst the draperies should be treated as being thin in texture, voluminous, accommodated to the limbs, and moulded into deep simple folds. I believe that works executed upon this principle would often be taken for old ones of very superior quality. No doubt to achieve such works would require far higher artistic power than is generally now employed in glass painting, and a vast deal more time to be bestowed on their preparation than is now required, all which would tend to increase their cost. But having confidence in the common sense of the country, I believe if the matter were properly presented to their minds, that most patrons of glass painting would prefer possessing one Picture window in a church, exhibiting a decent display of art, all the other windows being filled with good Pattern glass paintings, instead of being content as now with having every window filled with the veriest trash under the denomination of Pictures. The present want of artists to execute such works is no argument against the system, since we may be sure that plenty of artists would come forward as soon as they ascertained that their services were required. If the system is correct, there can be no insuperable difficulty in working it out.

Mr. M. Digby Wyatt, Hon. Sec., called attention to some drawings exhibited by Mr. Waring, Associate, which illustrated the principles laid down by Mr. Winston. He added that the best con-

firmation of Mr. Winston's opinions might be found in the works of the early Italian masters who studied entirely from the remains of Greek art, and whose pictures if transferred to glass would make the most perfect glass paintings that could be had.

Mr. Waring, Associate, said that in the drawings exhibited his object had been to shew that the best painting was applicable to glass as well as to any other material. In glass painting especially the end justified the means, and if the effect was striking and beautiful it was absurd to quarrel with the material. A general feeling existed that opaque objects should not be painted on glass, but in the drawings before the meeting representing windows in the Duomo of Florence, executed in the early part of the 15th century, colour was the means of producing the effect. The drawing was excellent, but colour was the great point the artists had in view. He had seen nothing in oil painting approaching the excellence of these works, and he believed when a painter witnessed the effect produced by the richness and brilliancy of them when the sun shone through them he would be tempted to throw away oils in despair. Tuscany was particularly rich in specimens of painted glass, and it was a matter of surprise that so many artists had visited Italy without describing or illustrating the numerous specimens there to be found. Mr. Waring gave the dates of the windows shewn in his drawings, and the names of the artists by whom they were executed.* He drew attention to the fact that in these works the design was made without regard to the intersections by the lead line, and he believed from examination of numerous specimens that the lead line far from destroying the effect of glass paintings rather added to it. In the specimen, from the Jerusalem Chamber, exhibited by Mr. Winston, the lead line went completely across the head of the Saviour, but if seen at a distance that lead line could never be observed. The idea conveyed by these works was that of a beautiful work in mosaic rather than a painting. The idea of the injurious effect of the lead line had induced a mode of treatment in modern works which produced the effect of transparencies rather than mosaic work. This was the case with some of the specimens exhibited in the Great Exhibition of 1851.

Mr. M. Digby Wyatt, said that in a former discussion of the subject there appeared to be some difficulty in understanding how it was that the black line was essential to beauty in stained glass. The reason was that those colours which transmitted most light were apt to spread upon the adjoining colours, and therefore unless the black line went round the light parts the whole windows would fuse, and the lighter parts would appear to eat up the shadows.

Mr. Donaldson, Hon. Sec. for Foreign Correspondence, observed that in glass painting one obvious requirement was, that there should be no large surface of any one unbroken colour. The object was to fill up, in one way or other, whether by black lines or by ornament, all the spaces, so that they should mould one into the other and yet have a line of demarcation; but there was no great mass of unbroken colour in any one part whatever. Therefore, in the example shown by Mr. Winston, a portion of a Jesse window, although the whole was cut up into small parts, it still formed an agreeable composition. In another specimen shown by Mr. Winston, the figures were made to occupy as much as possible of the whole space, leaving as little ground as possible dividing them; and he believed Mr. Winston could find that in his own design rather too much ground was left, the figures being too small. In the old works large and powerful masses of dark colour formed the predominant tints, to which the other colours were subordinate. In examining the various examples of different ages he

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* St. James, from the Transept of the Cathedral, Florence.
Prophets and Saints, from the same place, ascribed to Francesco Gambassi, 1434, but certainly earlier.
St. Matthew and St. Mark, from the Choir, Lucca Cathedral. Ugolino da Pisa, 1489.
Virgin and her Child, from the North Transept, Sta. Maria, Novella, Florence. Alessandro Fiorentino, 1491.

had always felt that these were some of the principles which had guided the best painters on glass; and to a great degree the effect had been irrespective of the forms of any particular period. He believed the forms of any period might be made harmonious; provided these leading elements were adhered to with regard to the combinations of colour. Mr. Winston's design was an effort to get rid of the trammels which bound down modern artists. In France the art had recently been carried out very successfully.

Mr. Winston stated that in his own design he had given more ground round the figures purposely to counteract the spread of colour in the figures, which, it would be observed, were invariably coloured lighter than the ground of the panel. In the example shown from the Jerusalem Chamber the effect was not satisfactory because the figures were so crowded that there was not sufficient ground to cut them clearly out.

Mr. Donaldson was of opinion that there should be very little ground, but that that should be of a very deep colour. Glass painting should be treated like bas relief in sculpture. In the bas reliefs of the Parthenon and the tombs of the Greeks, especially of the later period, and in the Roman triumphal columns, the proportions of the figures were rather large and gross, in order to fill up the ground. This was necessary in order to produce fullness and richness of effect, and to prevent poverty of expression in the figures.

Mr. M. D. Wyatt, said that the principle in ancient art was to allow sufficient ground where poverty of action was intended, but where continuous and moving action was required, as in the Parthenon and Trajan's Column, they filled up the whole of the ground. The same law would hold good in glass painting, but for the swelling of the colour of the light parts. He therefore agreed with Mr. Winston that a larger proportion of ground was necessary in glass painting than in any other branch of art.

The Chairman (Mr. Tite, M.P., V.P.), observed that the want of success attending modern English glass painting, as compared with that of France, arose as much from a want of combination of colour as from a want of character in the design. Many costly attempts had been made in which the colouring was utterly inharmonious; and the want of character in the imitation of ancient glass was equally remarkable. In some recent cases, as at Ely Cathedral, the object appeared to be to copy all the ugliness of ancient glass; and he sincerely wished some of the ameliorations, proposed by Mr. Winston, might be introduced. The meeting were deeply indebted to that gentleman for his able illustrations of the subject, and especially for the elegant design submitted in illustration of his own views.

A vote of thanks to Mr. Winston having been carried unanimously, The Chairman addressed the meeting on the close of the Session, and said that he was requested to mention, for the purpose of obtaining the support of the members of the Institute, the fact that the Architectural Exhibition proposed to make another collection, which, he hoped, would be equal in interest to the one just closed. This collection would be opened to the public from the 17th December till near the end of February, and he trusted the gentlemen present would readily contribute drawings to an exhibition which had done so much for the advancement of professional knowledge, and which was so highly creditable to the profession.

The Chairman then begged to say one word in reference to himself. He had had the honour of opening the present Session of the Institute with some remarks which were received more kindly than they deserved, but which had led to another class of remarks, in which he appeared to have been misunderstood, and he wished particularly to refer to the latter, as he was exceedingly anxious to stand well with the younger members of the profession. In the outset of his address of the 11th November last,

he had mentioned, in terms which he intended to be complimentary, *the Architectural Association.* He could really only repeat what he had then said—that he thought an association of that kind deserved to be encouraged, and he had done his best to encourage it. He had gone there at some inconvenience on a most tempestuous night, and felt much interested in all he heard. It was a step in the right direction, and the desire of the members for a diploma was, in his opinion, much to be commended. He was sorry, therefore, that anything he had said or was supposed to have said should have been misunderstood. Some gentlemen of that Association seemed to think that he had spoken slightingly of it, but he had no such intention. In early youth, his friend Mr. Donaldson, with himself and some other young architects had endeavoured to associate with similar objects, he therefore felt especially interested in the Association, and he only wished the members of it would do as he had done in subsequent years, that is, join the Institute, and thus constitute one body instead of two. He thought that suggestion was worth their consideration, and if he did not think well of them he certainly should not invite them to join the Institute. He regretted that he had been misunderstood, as he had a sincere regard for all young students, and especial sympathy for all who wished to embark in so difficult a profession as Architecture. (Cheers.) There was another subject to which he had ventured to allude at the opening meeting, namely, the cultivation of Mediæval to the neglect of Classical architecture, and he was extremely sorry that their Vice-President, Mr. Scott, was not present, probably in consequence of his engagement at St. Albans to-morrow. If he (the Chairman) had been sure that his other duties would have enabled him to attend this evening, he should have given that gentleman notice of his intention, because some remarks of Mr. Scott's had been read when he (the Chairman) was absent, in reference to the subject referred to, and had been issued to the members through the ordinary channel. On this communication he wished to make some observations, which he hoped and believed might not be unacceptable to the meeting. Mr. Scott's letter was called. "A reply to some remarks made at the Ordinary General Meeting, November 19th, 1855." Now, in that letter Mr. Scott remarked that—"In a society which supposes each of its members to hold his own individual opinion, and to express them freely as he pleases, it may appear unnecessary to notice mere manifestation of feelings which every one knows our respected friend entertains; but coming *ex cathedrâ* from the Chair of our Institute, and from our parliamentary representative, they may, if unanswered, appear to acquire more weight than belongs to them, and be viewed not as the feelings of an individual member only, but as those of the Institute as a body; in which case it would naturally become the duty of those who hold contrary opinions to make a formal protest, or to separate themselves from the Society." This passage contained two suggestions from which he (the Chairman) must dissent. He had the honour of representing a large constituency, but certainly not the Architects of England nor the Institute, and anything he might say there or in another place should only be received as the expression of his individual opinion. If he came forward officially as Chairman and stated that he was instructed by the Council to say this or that, the case would be different, but at the opening meeting he merely expressed his own opinions, opinions for which he held himself responsible, and with which the Institute as a constituted body had nothing to do. He repeated that he was not the representative of the Architects, but of another constituency, that he held himself responsible to that constituency but not to the Architects. To return to the question at issue he must be allowed to be again guilty of the sin of telling the younger members of the profession what he was most desirous they should learn, namely, that while they were studying Mediæval architecture they should not forget that there was such a thing as Greek or Italian architecture, and he could not enforce this point more than by reminding them that the Royal Academy medal had not been competed for, apparently in con-

sequence of the study of Mediæval architecture having been pushed, as he thought, to a dangerous extent. He would not renew the vexed question as to which was the best style of architecture for modern purposes. He, as every other man, had his own opinion on that, but he would say as a Protestant, that a Protestant church ought to be convenient for the services for which it was intended; and it did appear to him that many modern Mediæval churches were not well adapted to the main purposes for which they were intended. In his former remarks he had quoted a high authority, that of Mr. Petit, and which he begged to quote again. Mr. Petit observed, "There are good reasons why we should rather make the best of our old churches, than materially alter them or destroy them to build others in their room: the impression they are calculated to produce more than compensates for some inconvenience in their form or arrangement; but there seems no reason why we should ever plan or build a new church of an inconvenient form, or in any way unsuited to our manner of worship. If, for instance, it is desirable that all the congregation should be within sight and hearing of the minister, why should a church ever be built in which a part of the congregation is hidden from him when he performs any part of the service in the usual place? And this must be the case in every church having aisles which terminate at the division between the nave and chancel. If we find that galleries are useful and convenient, why should we build churches that will not bear galleries, or to which they are a disfigurement? If we professedly adopt high-pitched roofs as suitable to our climate, why should we ever combine them in such a manner as to leave a lodgment for snow or rain? There may be difference of opinion as to the advantage of an unbroken area, or the expediency of galleries; still they serve my purpose in illustrating the proposition I would advance, which is, that an architect ought not to abandon a convenient arrangement on account of its ugliness, but rather try to get rid of the ugliness without giving up the convenience. If, then, a feeling that his first object is to make his building fully answer his primary purpose, and a determination that nothing shall be allowed to interfere with this object, be referable to a spirit of utilitarianism, I conceive that so far, at least, an architect ought to be a utilitarian." This was the end and aim of his (the Chairman's) argument. They should not be led by the desire of imitating ancient examples, however beautiful, into neglecting the infinitely more important object of public worship, or diminishing, by the character of the building, the convenience of the worshippers assembled in it. On the point of taste he thought his friend Mr. Scott had been a little uncandid with him. In objecting to Gothic churches in modern squares, he had quoted some instances in the neighbourhood of his own residence. These squares consisted of regular masses of houses elegant in themselves, but, forming one side of the square, an irregular Gothic church was placed, which had no fitness, and was inharmonious with the lines and masses of the houses, and, in his opinion, inconvenient internally for a large and crowded congregation. Nothing could be more elegant than a Gothic spire in the country amongst trees and fields, and irregular forms added to picturesque beauty, where it was not necessary to crowd many people into the building; but in London, where it was necessary to accommodate probably 1,500 people in a church, and where it was desirable so to place them that all might hear, niceties of technical detail should be forgotten, and utilitarianism and the real object for which the churches were built should be regarded. Mr. Scott had objected to him for suggesting as objects worthy of imitation the examples of the Romanists. This he did because that class of the Roman Catholic clergy who gave great attention to public preaching particularly connected architectural fitness in their arrangements. As evidence of this, take the great church at Pisa, built by Vasari, or the great churches at Florence: in them was found no heaping together of columns or tiers to interfere with the sight or sound. Preaching in most cases in the Catholic churches was only incidental,

and at Milan and other places he had seen preachers ascend the galleries while large numbers gathered round them, but very few except those immediately near to the preacher could hear him. This was of less importance in Roman Catholic churches, because, as he had already stated, except in the case of the preaching friars, the sermon was considered incidental, and not essential; but in Protestant churches the congregation went as much to hear as to pray and to worship together. The deep and narrow chancels of Mediæval churches were also admirably adapted to the service of the mass, but not at all to the communion of the Protestant church, especially in the crowded parishes of London, where there were sometimes 800 or 900 communicants, who in such a building must be led up a few at a time, rendering a service, already too long for weak and delicate people, painfully longer. His friend Mr. Scott was one of the most able exponents of Mediæval architecture, and had executed many fine examples of it; but he could not help thinking that Sir Christopher Wren, in St. James's Church, Piccadilly, had produced a building internally far more appropriate and useful for a large congregation than Mr. Scott's elegant, but inconvenient arrangements. He did not wish to commit any gentleman to these opinions; but they were his own, and he thought an architectural "Tract for the Times" was wanted. They should do their best to restore ancient churches, and protect them from destruction; but a Protestant church in a city, for a large congregation, should be adapted to the wants and conveniences of the worshippers, and the peculiarities of the Protestant services. His object in these remarks was rather to set himself right with the profession than to invite any discussion of the subject, though he should be happy to enter upon such a topic if proper notice of it were given. He would merely add, that Mr. Scott had indulged in a little criticism respecting a Gothic church which he (the Chairman) had referred to, and in which, though elegant in itself, he thought the worst evils of the existing system were exaggerated. Mr. Scott availed himself of a misprint as to a date to be eloquent in his criticism; but it must have been clear, from the context, that he (the Chairman) was speaking of the time and style of Edward the First, and not of Edward the Third. Such criticism was therefore hardly worthy of the subject. The main point, in his opinion, was that a Protestant church ought to be built in the most convenient form for Protestant worship, and he contended that the Mediæval plans were not adapted to such purposes.

Mr. Jennings, Fellow, said that he had objected to Mr. Scott's paper being read in the absence of the Chairman, but was overruled by the Council. He concurred in the Chairman's views generally, but thought the fault of the frequent adoption of Gothic architecture rested as much with patrons as with architects. A Grecian or Roman design for a church would inevitably be rejected. It was most desirable that the question should be so discussed, that the public should be led to adopt a style in which seeing and hearing could be best provided for. A Grecian or Roman church would not be more expensive than a Gothic one. With regard to any discussion of the question, the Council had felt that it was likely to lead to irritation, and that it was better that each architect should act upon his own opinion.

Mr. Papworth, Fellow, said that after the reading of Mr. Scott's letter (which had been received by the meeting with silent astonishment) he had received an assurance from the Council that an evening should be fixed for the discussion of the question.

The Chairman said that Mr. Papworth's feelings, he was sure, had due weight with the Council, but he did not think any great advantage would be gained by a discussion of the subject at that moment. His own remarks had merely been by way of explanation. No doubt it could be discussed with advantage, and correct information might be obtained as to the relative cost and accommodation of Mediæval and Classical churches. Architects, like all who lived to please, "must

please to live;" but men of taste could and should give a right direction to the public mind. Probably next Session they might enter upon such a discussion with advantage, and certainly without any ill feeling, and the recess would afford an opportunity for further considering it. In their foreign travels, during the recess, he urged the members to remember the Institute, and to glean information which might be useful to it, and especially to study foreign churches in relation to the religion of those countries, and their appropriateness to the forms of those religions. They should look with more kindness and courtesy to the services of the Roman Catholic church than was frequently displayed, and endeavour to understand them. This would enable them to come to the discussion of questions of this kind with a kindly feeling and in a Christian spirit.

Royal Institute of British Architects,

Incorporated 7th William IV.

Session 1855-56.

16, *Grosvenor Street*,
July 7th, 1856.

Dear Sir,

By direction of the Council, we beg to forward you the annexed Resolution, passed unanimously at their Meeting on the 5th instant.

"That 5 per cent. upon outlay has been, and is, the only rate of charge recognized by the profession, as fairly remunerative in the average practice of Architects.—That it is to be deeply regretted that it should be proposed to depart from the above rate in the instance of the New Palace at Westminster; a building involving in its design and execution the exercise of the highest professional attainments.—That the example which would be set by Her Majesty's Government, should the course proposed be carried into execution, (a legal appeal against their decision being practically impossible) is to be regarded as disastrous to the future prospects of Architecture as a liberal profession in this country,—as calculated to lower the character of public monuments in England, and unworthy the Government of a great nation, whose obvious duty it is adequately to foster and protect the genius of its artists."

We are, dear Sir,
Very faithfully yours,

C. C. NELSON, } *Honorary*
M. D. WYATT, } *Secretaries.*

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READ AT THE ANNUAL GENERAL MEETING HELD 5TH MAY, 1856.

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Samuel Sanders Teulon, 2, Lansdown Place, Brunswick Square.
*James Thomson, 57, Devonshire Street, Portland Place.

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G. Vulliamy, 26, Suffolk Street, Pall Mall East.
F. S. Waller, Gloucester.
W. W. Wardell, the Green Hill, Hampstead.
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G. B. Williams, 4½, Frederick's Place, Old Jewry.
T. Willoughby, 11*a*, Cunningham Place, St. John's Wood Road.
*Sancton Wood, 10, Craig's Court, Charing Cross.
*Edmund Woodthorpe, 28A, Basinghall Street.
†*Thomas H. Wyatt, 77, Great Russell Street, Bloomsbury Square.
*M. Digby Wyatt, 54, Guilford Street, Russell Square.

HONORARY FELLOWS.

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The Most Hon. the Marquis of Lansdowne, k.g. f.r.s., Berkeley Square.
The Right Hon. the Earl of Aberdeen, k.g. f.r.s., Argyll Street.
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Charles Morrison, Esq., 57, Upper Harley Street.
Charles H. C. Lang, Esq., m.d., 3, Howley Place Villas, Notting Hill.
(D) William R. Hamilton, Esq., f.r.s., 12, Bolton Row.
Samuel Ware, Esq., 34, Portland Place.
Beriah Botfield, Esq., f.r.s., 9, Stratton Street, Piccadilly.
Henry Thomas Hope, Esq., 116, Piccadilly.
Alexander J. B. Hope, Esq., 1, Connaught Place, Hyde Park.

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The Rev. R. Willis, m.a. f.r.s., Jacksonian Professor, Cambridge, and 23, York Terrace, Regent's Park.
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(D) Sir Gardner Wilkinson, F.R.S., 33, York Street, Portman Square.
The Rev. Richard Burgess, B.D., 10, Cadogan Place.
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(D) James Walker, Esq., F.R.S., 23, Great George Street.
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Eaton Hodgkinson, Esq., F.R.S., 44, Drayton Grove, Brompton.
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	Christian Hansen, Architect	*Trieste.*
(D)	Professor C. F. Ludwig Förster, Architect	*Vienna.*
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	J. P. Cluysenaar, Architect Monsieur Suys, Architect to H. M. the King of the Belgians	*Brussels.*
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	Brunot Renard, Architect	*Tournay.*
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	G. Hetsch, Architect	*Copenhagen.*
FRANCE:—		
	Firmin Epellet, Architect of the Department of the Pas de Calais	*Arras.*
	Monsieur Guy, City Architect Monsieur de Caumont	*Caen.*
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	F. Brunet-Debaines, Architect	*Hâvre.*
	Monsieur Benvignat, Architect	*Lille.*
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MONSIEUR ARMAND
MONSIEUR PELLECHET
ROHAULT DE FLEURY — Architects — *Paris.*

MONSIEUR FRIES, Architect — *Strasburg.*
CHENAVARD, Architect — *Lyons.*
MOREY, Architect — *Nantes.*

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Baden—

HEINRICH HÜBSCH, Architect — *Carlsruhe.*

Bavaria—

CHEVALIER LEO VON KLENZE, Privy Counsellor of H.M. the King of Bavaria
HERR METZGER
FRIEDRICH ZIEBLAND — Architects — *Munich.*

German States—

PROFESSOR F. N. HESSEMER
FRIEDRICH PEIPERS — Architects — *Frankfort on the Maine.*

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HERR FISCHER, Architect — *Saxe Coburg.*

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Prussia—

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HERR BUSSE, Architect, Director of the Academy of Public Constructions
AUGUST STÜLER, Architect to H. M. the King of Prussia
HEINRICH STRACK, Architect, Professor of the R. Academy of Fine Arts
HERR WILHELM ZAHN — *Berlin.*

HERR SULPICE BOISSERÉE, Architect — *Bonn.*
HERR ZWIRNER, Architect — *Cologne.*

Saxony—

HERR GEUTEBRÜCK, Architect of the University — *Leipzig.*

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HOLLAND:

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— Besia, Member and Professor of the I. and R. Academy of the Fine Arts - - - *Milan.*
Il Conte Selvatico - - - *Venice.*
Conte Orte di Manara - - - *Verona.*
The Abate Antonio Magrini.
Signor Miglioranza, Architect. } - - *Vicenza.*
Cavaliere Niccolò Matas.
Cavaliere Pasquale Poccianti. } Architects - *Florence.*
Signor Antolini, Architect, Professor of Architecture at the Academy - - - *Bologna.*
Cavaliere Gio. Pietro Campana - -
(d) Commendatore Luigi Canina, Member of the Academy of St. Luke
Cavaliere Clemente Folchi, Architect, Vice President of the Academy of St. Luke - - - } *Rome.*
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Signor Bonucci.
Signor Achille Pulli. } - - *Naples.*
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Raffaelle Politi, *Girgenti.*
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RUSSIA:—

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SWEDEN:—

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James Edmeston, Jun., 5, Crown Court, Old Broad Street.
George Enoch, 39, Hatton Garden.
(d) James Fergusson, 20, Langham Place.
Horace Field, 69, Lincoln's Inn Fields.

Richard Forster, 9, Warwick Crescent, Harrow Road.
Charles Fowler, Jun., 12, Furnival's Inn.
Francis E. H. Fowler, 4, Garden Court, Temple.
Henry R. Fricker, 88, Great Tower Street.
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T. Harris, 48, Conduit Street.
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J. H. Hirst, Bristol.
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Horace Jones, 16, Furnival's Inn.
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E. J. Kelly, 23, Thavies Inn.
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Edwin Nash, 5, Adelaide Place, London Bridge.
H. R. Newton, 6, Argyll Street.
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R. Nicholson, 36, Essex Street, Strand.
John Norton, 24, Old Bond Street.

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R. M. Phipson, 3, Dane's Inn, Strand.
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R. Reynolds Rowe, 10, Emmanuel Street, Cambridge.
T. H. Rushforth, 1, Trinity Place, Charing Cross.
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Stephen Salter, Jun., 26, Parliament Street.
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George Saunders, Hammersmith Terrace.
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J. P. Seddon, Llandaff, Glamorganshire.
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B. Smith, 15, Stratford Place, Oxford Street.
C. Smith, 18, College Place, Oakley Square.
T. R. Smith, 8, Adam Street, Adelphi.
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Lewis Stride, 6, Bloomsbury Square.
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T. C. Tarring, 2, Gloucester Terrace, Victoria Park Road, Hackney.
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C. B. Thurston, 9, Southampton Street, Bloomsbury Square.
S. W. Tracey, Ipswich.
J. F. Wadmore, 35, Gt. St. Helens, Bishopsgate.
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F. Warren, The Grove, Kentish Town.
M. Warton, 5, Nicholas Lane, Lombard Street.
R. Warton, Jun., Finchley.
G. J. Wigley, 51, Manchester Street.
William Wiggington, Dudley, Worcestershire.

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T. J. Willson, Burnley, Lancashire.
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CONTRIBUTING VISITORS.

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William Hawkes, Esq., Edgbaston, Birmingham.
David Q. Henriques, Esq., 10, Upper Wimpole Street.
Peter N. Laurie, Esq., 6, Park Square West, Regent's Park.
G. J. Morant, Esq., Hendon.
William Thomas Nixon, Esq., 22, Leicester Square.
Henry Twining, Esq., Grove Lodge, Clapham.

REPORT OF THE COUNCIL

TO THE ANNUAL MEETING, MAY 5TH, 1856.

THOUGH causes, happily now removed, have existed during the last two years to direct public attention and expenditure to other objects than the pursuits of peace to which this Institute is devoted, the Council have the gratification of stating that the list of Members has fully maintained its average increase, and that the balance sheet consequently exhibits a satisfactory financial result.

Ten gentlemen have become Fellows, six of whom were previously Associates, fourteen gentlemen have become Associates, two Honorary Members, two Honorary and Corresponding Members, and two Contributing Visitors.

During the same time, one Fellow and three Associates have retired, and the Institute has to regret the decease of Messrs. G. T. Andrews, A. J. Green, J. E. Gregan, Fellows; of J. Neeld, and W. M. Nurse, Esquires, Honorary Fellows; of Cavaliere Pietro Nobile, Herr Sprenger, and Mynheer Weenink, Honorary and Corresponding Members.

In the Honorary Members who have joined, the Council have the satisfaction of recognising the learned Editor of the Fourth Volume of Stuart's Antiquities of Athens, Mr. Joseph Woods; a well known authority on Lithology, Mr. C. H. Smith; a leading Architect at Stockholm, M. Axel Nyström; and the Author of a work highly prized by the admirers of Mediæval Architectural Archæology, M. Viollet-le-Duc, of Paris.*

Though not Members of the Society, it may here be permitted to allude, with feelings of respect and regret, to the decease of another Parisian Architect, M. Letarouilly, who has not survived to witness the completion of his highly valuable work on the Edifices of Modern Rome; and of Mr. Thomas

* The Institute now consists of 136 Fellows, 127 Associates, 15 Honorary Fellows, 18 Honorary Members, 81 Honorary and Corresponding Members, and 7 Contributing Visitors.

Cubitt, one whose name may pass as a synonym for the boldness and magnitude of the building undertakings of the present day, in this our modern Babylon.

Under the highest sanction, the Royal Medal was this year awarded to an English Architect—Mr. Tite, M.P., Fellow, on whom our noble President passed a very high eulogium when presenting it, at a very numerous meeting of the Members and Visitors of the Institute.

The competition for the Medals having been much more satisfactory than on many previous occasions, the Soane Medallion was awarded for the first time since the year 1848, and Medals of Merit were given to two other competitors. The numerous applications for the printed conditions of the competition of the present year induce the hope that the drawings to be expected will equal those which have just been rewarded. The new class of subjects offered for the Institute Medals will, it is trusted, meet with due attention from natives of Ireland and Scotland, anxious to bring to light the remains of interesting buildings in those countries which have been hitherto neglected, or known only to a few.

It would be satisfactory to be enabled to state that the prize offered to the Students class had excited the same spirit of emulation.

The new Metropolitan Building Bill, introduced during the last Session of Parliament by the late Sir W. Molesworth, then First Commissioner of Works and Public Buildings, received due attention from the Committee entrusted by the Institute with the charge of watching its progress, under the able Chairmanship of Mr. Tite. Modifications were introduced in certain portions to which objections had been raised, and the Council feel it due to Mr. Tite to record the special attention which he gave to supporting the interests of the profession both before the Special Committee of the House and in his place in the House itself; and particularly to state, that through his instrumentality the clause empowering the Institute to examine applicants and grant certificates of competency to discharge the duties of District Surveyor was introduced into the Act; a clause, it should be borne in mind, which recognizes this Institute as a Body essentially conducive to the general welfare of the community.

The Examiners appointed under this Act, viz., the Vice-Presidents and Honorary Secretaries for the time being, with certain other Fellows to be

chosen annually by the Institute, have already held two Quarterly Meetings. Applicants, on passing their examination, receive a certificate of competency under the Corporate Seal of the Institute, which renders them eligible for election to the office of District Surveyor by the Metropolitan Board of Works, to which the charge of selection is now intrusted. In examining applicants and granting Certificates, the Institute proceeds on the definite understanding that the Corporate seal is affixed to the document solely to enable the parties to seek admission as District Surveyors under the Metropolitan Buildings Act, and not for the purpose of canvassing for any other office whatever.

As soon as the Metropolitan Board of Works was constituted, the Council of this Institute represented to the Chairman the necessity for passing certain regulations respecting the width of streets, which had been omitted in the Building Act, and they have the satisfaction to state that prompt and satisfactory attention was given to their representation.

The results of two important competitions have recently been made known—one for Barracks to be constructed for Cavalry and Infantry throughout England, the other for a Cathedral, at Lille, in France. In both these competitions it is highly satisfactory to find that Members of this Institute have carried off the first premiums, especially in the latter case, which is now the third instance within a few years of an English Architect, and a Member, being the author of the approved designs for a continental public building.

Nor were the Members less successful in their endeavours to respond worthily to the invitation to display proofs of their skill at the Paris International Exhibition, 1855, as the official returns shew that, with only three exceptions, all the English Architects to whom medals or honourable mention were adjudged are Fellows or Associates of this Society; Sir Charles Barry having received one of the two grand medals of honour; Messrs. Cockerell, Owen Jones, Thomas Leverton Donaldson, Philip Hardwick, and Gilbert Scott, medals; Messrs. Decimus Burton, Charles Fowler, sen., Thomas H. Wyatt, Thomas Allom, Digby Wyatt, and Kendall, junior, honourable mention.

The objects connected with Architecture, shown in the same Exhibition, were brought under the notice of Members in some able comments by Mr. Papworth, Fellow, at the commencement of this Session. Mr. Tite, V. P., in his opening address to the Institute, called attention to a question of much importance to the profession, which has for some time past engaged much

attention, and been warmly advocated both at home and abroad—that of a Diploma in Architecture. The subject was fully discussed at Meetings of the Members, and representations in favour of the proposed measure were received from the Architectural Societies of London, Liverpool, and Birmingham. The matter, having been referred to the Council, was duly considered by them, and the following Resolution was subsequently forwarded in reply to the communications from the three Societies.

"That the Council feel that it is as yet premature to pronounce an opinion upon a subject of so great importance as the establishment of an examination with reference to granting a Diploma in Architecture. That before they could recommend the Institute to undertake such a charge, it would be necessary carefully to ascertain the opinions of Members of the Profession generally.

"They moreover feel that the duty which has been recently intrusted to the Institute by the Legislature, namely, the Examination of the Candidates for the Office of District Surveyor, will enable them, after a sufficient experience of such Examinations, to come to a sounder judgment than they can at present on the subject of the Diploma."

A case of disputed professional charge referred to the Council for decision was carefully investigated, and the parties interested, though nowise connected with the Institute, obtained a final settlement of the point in dispute without either delay or pecuniary expenditure—items which too often attend the solution of such cases when referred to legal arbitration.

At the request of the Committee, the Council examined and drew up some brief observations on the objects connected with building in the Architectural Exhibition, 1855-56, which were afterwards laid before a Meeting of the Exhibitors. The Council would here repeat their conviction, then stated, that the periodical collection of such objects in an Exhibition devoted entirely to Architectural purposes, must be highly advantageous to the public, as well as to Architects and the Exhibitors.

Among the various subjects which have been submitted to the consideration of the Members and Visitors at the Evening Meetings, it may be allowed to refer to the interesting discussion and the varied information which was elicited by Mr. C. H. Smith's paper on the Forms of Bells, in which the mode of casting and hanging the large bell intended for the Clock Tower of the New Palace,

at Westminster, was ably described by Mr. Edmund Beckett Denison. At a later period of the Session, Mr. Wigley, Associate, communicated the result of his personal Archæological researches in Jerusalem, in two very interesting papers, in which he evinced perfect knowledge of his theme, and strongly advocated the claims of the Holy Land to be considered the country whence the Mediæval Architecture, known generally as Gothic, was introduced into the various countries of Europe.

The Members will have learnt from the letter forwarded to them by Mr. Scoles, Honorary Secretary, that he declines being again put in nomination for that office. The Council feel that the Institute must sincerely regret the loss of the valuable services rendered for the last ten years with so much urbanity and skill by Mr. Scoles, in addition to the assistance which he has afforded during more than twenty years as a Member, who joined the Institute very soon after its establishment.

The Council have much satisfaction in recommending that the Honorary office thus vacant should be confided to Mr. Digby Wyatt, whose name is well known in connexion with the Fine Arts, both at home and abroad, and who has consented to be put in nomination at the request of many influential Members of the Institute.

The ultimate appropriation of the important central site now covered by the ruins of one of our largest Metroplitan Theatres—a building with which the name of one of our highly respected Honorary Fellows is intimately associated—the extensive measures contemplated by the Government for the concentration of numerous public offices in the neighbourhood of Whitehall and the New Palace at Westminster; the improved communications proposed to be made in connexion with St. James' Park; the removal of the National Gallery from Trafalgar Square, and the contemplated appropriation of the site to an Hotel, rivalling in extent the building recently erected for similar purposes in the heart of Paris; and last, though not least, the solution of the question which has arisen as to the professional remuneration of Architects employed on National Works, are topics in which all Members of the Institute must feel a deep interest, especially the last, which may involve the establishment of a precedent highly unjust and injurious.

The Council, having ventured to suggest to the Directors of the East India Company the advantage of allowing the interesting set of drawings, ex-

hibited last Session, of Buildings at Beejapoore, to be copied for distribution, have much pleasure in learning from Mr. Fergusson, Associate, through whose intervention the drawings were made, that Photograph copies are now being made under his direction—an instance of attention to the interests of Art on the part of the Honourable Company well worthy of imitation by other Public Bodies.

The principal additions during the year to the Library and Collection, consist of drawings by, and the portrait of Mr. Bond, Architect, bequeathed by the late Mr. Field, a gentleman well known for his work on Colours; the Continuation of Lepsius' Work on Egypt, a Royal gift; the three volumes required to complete Roberts' Egypt and the Holy Land, and the first numbers of a comprehensive Work on Ornament, presented by the Author, Owen Jones, Fellow.

Application has been forwarded by the Council to the French Minister of State, requesting that this Society may be placed on the list of Scientific Bodies to which Copies of the Work on the Mediæval Buildings in France, published by the Government, are presented. Some interesting medals, having on the reverse representations of important edifices, and sundry prints, illustrative of French palaces, from the Collection at the Louvre, have been purchased.

The addition of £200. Stock to the Funded Property, and the balance now in hand, display a satisfactory state of affairs, to the maintenance of which each Member is invited, by individual and conjoint operation, still further to contribute.

General Account of the Receipts and Disbursements from December 31st, 1854, to December 31st, 1855.

RECEIPTS.

1855.				£	s.	d.
To Balance in the hands of the Treasurer, Dec. 31, 1854..	366	4	11			
— Ditto in the hands of the Librarian		1	11			
— Ditto ditto for Attendant's Salary, one Quarter in advance.....	11	10	0			
				377	16	10
— Admission Fees of three Fellows at £5. 5*s*.....	15	15	0			
— Subscriptions of Fellows	388	10	0			
— Arrears of Subscriptions of one Fellow for previous years.....	12	12	0			
— Admission Fees of eleven Associates ..... at £1. 1*s*.	11	11	0			
— Subscriptions of Associates	233	1	9			
— F. T. Digweed, Associate, paid in excess	1	1	0			
— Part of Arrears of Subscriptions of Associates for previous years	12	12	0			
— Subscriptions of four Students..... at £1. 1*s*.	4	4	0			
— Ditto six Contributing Visitors.. at £2. 2*s*.	12	12	0			
				691	18	9
— *Dividends on Stock: viz.*—						
One Year's Dividend on £1747. 14*s*. 3*d*., £3 per Cent. Consols (less Income Tax)	49	3	1			
One Year's Dividend on £139. 17*s*. 3*d*., £3 per Cent. Reduced Annuities (less Income Tax)	4	3	10			
				53	6	11
— Donation to the Library Fund, from W. J. Booth, Fellow		....		5	5	0
				£1128	7	6

EXPENDITURE.

1855.	£	s.	d.
By Rent for One Year and a Quarter, from September 29th, 1854, to December 25th, 1855.....	250	0	0
— Taxes, and Insurance of the Books, Collection, &c.....	11	2	2
— Fuel and Light.....	20	16	8
— Attendance	57	5	1
— Librarian's Salary.....	105	0	0
— Printing, Lithography, &c. and Reporter (Printing and Reporter for One Year and a Quarter)	248	17	4
— Stationery, Postage, and Delivery of Letters, Advertisements, &c.....	66	16	8
— Purchase of Books, &c., Bookbinding, Freight and Duty on Foreign Books	17	4	7½
— Prize Books	4	10	0
— Furniture, Fittings, and Occasional Repairs.....	9	7	7
— Tea, Coffee, &c. at Evening Meetings (including extra Attendance).....	29	8	4
— Petty Disbursements	2	11	3½

— Balance in the hands of the Treasurer, Dec. 31st, 1855.....	293	4	11			
— Ditto in the hands of the Librarian.....		12	10			
— Ditto ditto for Attendant's Salary, one Quarter in advance.	11	10	0			
				305	7	9
				£1128	7	6

ASSETS.

				£.	s.	d.
Cash in the hands of the Treasurer and of the Librarian on Dec. 31st, 1855.....				305	7	9
Amounts due from Members: viz.—						
One Associate for subscription in arrear, Dec. 31, 1854	2	2	0			
Fellows for the year ending 31st December, 1855.....	23	2	0			
Associates ditto.....	15	15	3			
				40	19	3
				£346	7	0

LIABILITIES.

Rent, Salaries, and other current Expenses, from December 25th, 1855.

PROPERTY.

The Value of Copies of Transactions, and Reports on Competitions, on hand.
Books, Drawings, Prints, Models, Casts, Furniture, &c.

THE FUNDED STOCK of the Institute consists of:—

£1747. 14*s*. 3*d*. £3. per Cent. Consols.

£139. 17*s*. 3*d*. £3. per Cent. Reduced Annuities. (Travelling Fund).

J. J. SCOLES, *Hon. Sec.*

W. G. HABERSHON, *Fellow*,
A. J. BAKER, *Associate*, } *Auditors.* *May 2nd*, 1856.

Supplementary Balance Sheet to May 5th, 1856.

RECEIPTS.

	£.	s.	d.
To Balance in the hands of the Treasurer and Librarian, Dec. 31st, 1855	305	7	9
— Subscriptions of Members received from December 31st, 1855, to May 5th, 1856	623	14	0
— Composition of One Fellow	36	15	0
— Dividend on £1747. 14*s.* 3*d.*, £3. per Cent. Consols	24	9	4
— Ditto 139. 17*s.* 3*d.*, £3. per Cent. Reduced Annuities	2	1	11
	£992	8	0

EXPENDITURE.

	£.	s.	d.
By Rent, Taxes, Salaries, and other current Expenses, from December 31st, 1855	221	8	2
— Purchase of Stock, £200., £3. per cent. Consols	181	5	0
— Balance in the hands of Treasurer and Librarian	589	14	10
	£992	8	0

ASSETS.

	£.	s.	d.
Cash in the hands of the Treasurer and of the Librarian	589	14	10
Amount due from Members to May 5th, 1856	161	15	0

LIABILITIES.

Rent, Salaries, and other current Expenses, from March 25th, 1856.

PROPERTY.

The value of Copies of Transactions and Reports on Competitions on hand, Books, Drawings, Prints, Models, Casts, Furniture, &c.

The Funded Stock of the Institute consists of:—

£1947 14 3—£3. per cent. Consols.
139 17 3—£3. per cent. Reduced Annuities.

APPENDIX.

The Architectural portion of the Exposition Universelle of Paris in 1855, is a subject so important to the Profession generally, that it seems desirable to preserve a general statement and analysis of its Contributors and a classification of the Drawings, as a record of some of the leading particulars.

The following countries sent drawings—

	Works.	Exhibitors.
Austria	5	3
Bavaria	10	1
Belgium	1	1
England	127	50
France	654	93
Holland	5	3
Prussia		2
Spain	20	14
Sardinia	1	2
Sweden	7	2
Turkey	14	1

The French contributions appear in the Official Catalogue under two lists; the first one being in the general catalogue, the latter in a supplement at the end.

First General List.	
Contributors	69
Works—Engravings	86
Drawings of Painted Windows and Mural subjects	50
Drawings belonging to the Government Archives	244
	380
Drawings belonging to the artists of general subjects	113
	493

Supplement.	
Contributors	24
From the Archives of the Institute of France	131
Drawings of general subjects	6
	137
In general list	493
Total	630

Hence it appears that 375 were derived from the public archives, and about 120 drawings of general architectural subjects belonging to the artists.

Painters	13	Lithographer	1
Engravers	11	Architects	55

The drawings from the Public Archives were derived from the Ministries of State, and of Public Instruction, and from the Institute of France. These formed two classes of most elaborate illustrations of existing buildings. The one was that of the Mediæval edifices of France, measured and drawn with the utmost care and most refined taste, and marking the actual state of the several examples. Those from the Institute were the drawings of the classic monuments of Italy and Greece, studied and rendered with the minutest accuracy by the pensioned students of the French Academy at Rome, and illustrated with profound study and the highest intelligence. All these drawings are a standing evidence of the enlightened and judicious patronage of the French Government at every period, Republican, Imperial, and Royal, by whom the rising generation of artists is provided with the very highest education; being afforded the best means of instruction and study; and afterwards by public works ensured future encouragement. The results are evident in the high character of their public buildings. These illustrations are noble specimens of the talents of the French draughtsmen, and prove the advanced state of the school of drawing at the several periods, when they have been executed.

Without them the French contributions would have been unworthy the architects of that country. The absence of the names of many of the men in most extensive practice shows, that the Profession hardly realised the importance of the exhibition and their responsibility in fairly representing the works of living architects, in which the collection was singularly deficient. In fact, the authorities were extremely disappointed at an early period by the scarcity of contributions, which did not equal the English in number, and were obliged to send to the collections of the Public Archives in order to prevent the French section from being a comparative failure.

The contributions of Architectural subjects by Great Britain are all derived from England with the exception of those sent by Thomas Hamilton, Esq., of Edinburgh.

There were about 50 contributors, 119 drawings and 8 engravings. All these, it is to be observed, were the artists' own property, treating on general subjects, not one having been sent by the Government. The following are the names of the exhibitors.

Allen and Dudgeon.
Allom.
Banks and Barry.
Barry (Sir Charles.)
Brandon and Ritchie.
Bunning.
Burton
Butterfield.
Carpenter.
Clutton (Hy.)
Cockerell (Professor.)
Davies.
Digweed.
Donaldson (Professor.)
Falkener.
Fowler.
Gabriel and Hirst (Bristol.)
Gibson.
Hamilton (Edinburgh.)
Hansom.
Hardwick, P. (R.A.)
Hardwick, P. C.
Henman.
Hill (Leeds.)
Hopper.
I'Anson.
Jones (Owen.)
Kendall, H. E., jun.
Lamb.
Lockyer.
Paxton (Sir J.)
Penrose.
Potter.
Prichard & Seddon (Llandaff.)
Pullan.
Railton.
Salvin.
Scoles.
Scott (G.G.)
Sharpe (Lancaster.)
Shaw (H.)
Slater.
Smirke (S.)
Smith.
Tite.
White.
Worthington.
Wyatt (T. H.)
Wyatt (Digby.)

Messrs. Cockerell, Donaldson and Scott, were appointed by the Treasury a Committee of Architects, to select from the drawings sent in for transmission those which should be forwarded on to Paris.

Sir C. Barry and Professor Cockerell were Members of the Jury of the Class 30 for Architecture at Paris, the latter of whom received the decoration of the Legion of Honor, as well as Digby Wyatt, Esq., Member of the Jury of Class 24 for Furniture and Decoration.

The Medals awarded were as follows—

Grande Medaille d'Honneur.
Sir C. Barry.

Medailles de 1re Classe.
C. R. Cockerell.
Owen Jones.
T. L. Donaldson.

Medailles de 2e Classe.
Philip Hardwick, R.A.
G. G. Scott.
E. Falkener.
T. Hamilton (Edinburgh).

Honorable Mention.
Decimus Burton.
Charles Fowler.
Thomas Wyatt.
Thomas Allom.
Digby Wyatt.
H. E. Kendall, jun.
H. Shaw.

CONTRIBUTIONS

TO

THE COLLECTION AND THE LIBRARY OF THE INSTITUTE,

Between the 7th of May, 1855, *and the 5th of May*, 1856.

W. J. Booth, Fellow. The sum of Five Guineas to the Library Fund.

MISCELLANEOUS.

Sir Thomas Deane, Architect, Cork. Medal to Richard Sainthill, of Topsham, Numismatist. L. C. Wyon, 1855.

G. Field, (the late). A Portrait of the late J. L. Bond, Architect, by Singleton. Five Coloured Designs, by the late J. L. Bond, Architect; framed.

W. Wiggington, Associate. A Specimen of Z. Round's Patent Bricks to supersede the use of Wood Bricks. Models of the same in Wood.

PURCHASED.

Bronze Medals.	Pius VII.	*rev.* Coliseum.
,,	Benedict XIV.	*rev.* Vatican.
,,	Napoleon	*rev.* Museum.
	,,	,, Monument to Desaix.
,,	,,	,, Column to the Grand Army.
,,	,,	,, Arch of Triumph.
,,	,,	,, Temple at Spalatro.
,,	,,	,, Temple of Augustus, at Pola.
,,	,,	,, Brandenburgh Gate at Berlin.
Four Medals.	Belgian Town Halls.	
	Société des Architects.	
	G. G. Lethière, *rev.* Villa Medici.	
	D. Leroy.	

DRAWINGS AND PRINTS.

W. J. Booth, Fellow. Drawings and Tracings of Antique Ceilings, Plans, &c. From the Adams' Collection.

G. S. Clarke, Associate. Lithographic View of Messrs Munt, Brown and Co.'s New Warehouse, Wood Street, London. G. S. Clarke, Architect.

H. Garling, Fellow. Designs for Downing College, Cambridge. W. Porden, Architect.

Robert Hesketh, Fellow. Sheet of Sections of Party Walls, illustrating the Metropolitan Building Act, 1855.

J. M. Lockyer, Associate. Photographic View of Messrs. Heal's Premises, Tottenham Court Road. J. M. Lockyer, Architect.

R. W. Mylne, Fellow. Topographical Map of London and its Environs. By Robert W. Mylne, C.E., F.R.I.B.A., &c. Framed. 1855.

R. G. Withers, Associate. A View of Buttermere Church, Wilts. A View of Aberporth Church, Cardiganshire. A View of Landfair Nantgwyn Church, Pembrokeshire. A View of Llandugwydd Church, Cardiganshire, as rebuilt by R. J. Withers. Lithographs.

PURCHASED.

Engravings of French Palaces from the Calcographie of the Louvre, Paris.

BOOKS, PAMPHLETS, &c.

His Majesty the King of Prussia. Lepsius (C.R.) Denkmaeler aus Ægypten und Æthiopien. Achte Versendung. Lieferung 51—62. Plates large folio. Berlin, 1855.

Salzenberg, W. Alt-Christliche Baudenkmale von Constantinopel, vom V, bis XII, Jahrhundert. Auf Befehl Seiner Majestät des Königs Aufgenommen und Historisch erläutert von W. Salzenberg. Folio. Berlin, 1854.

The Society of Antiquaries. Archæologia. Vol. 36, Part 1. Proceedings, Nos. 41 & 42. List of Fellows for 1855.

The Architectural Institute of Scotland. Transactions. Vol. IV. Part 1.

The Council of the Architectural Museum. Catalogue of the Architectural Museum, 1855. 4to.

The Architectural Publication Society. Illustrations to the Dictionary of Architecture. Parts 1 & 2. The Dictionary of Architecture. Parts 5 & 6.

The Architectural Society of the Archdeaconry of Northampton. Reports and Papers read during the year 1854.

The Council of the Art Union of London Nineteenth Annual Report of the Council of the Art Union of London, with List of Subscribers. Art Union of London Almanack for 1856.

The Arundel Society. Catalogue of Select Examples of Ivory Carvings, from the Second to the Sixteenth Century, preserved in various Public and Private Collections in England and other Countries. By E. Oldfield, M.A. 4to. London, 1855. Descriptive Notice of the Drawings, Tracings, Models and Miscellaneous Publications of the Arundel Society, exhibited November 1855, in the Crystal Palace, Sydenham. Pamphlet, 8vo. London, 1855.

The Association for Improving the Dwellings and Domestic Condition of Agricultural Labourers in Scotland. Report (the First Annual) of the Directors of the Association for Improving the Dwellings and Domestic Condition of Agricultural Labourers in Scotland. 8vo. Edinburgh, 1855.

J. M. Blashfield. An Account of the History and Manufacture of Ancient and Modern Terra Cotta; and of its use in Architecture as a durable and elegant Material for Decoration. By J. M. Blashfield, M.R.I., &c. Pamphlet, 8vo. London, 1855.

Joseph Bonomi. The Proportions of the Human Figure, with Six Illustrative Outlines, by Joseph Bonomi, Sculptor. Pamphlet, 8vo. London, 1856.

W. J. Booth, Fellow. Gibbons (D.). The Metropolitan Buildings Act, 7th & 8th Vict. cap. 84, with Notes and an Index. By D. Gibbons. 8vo. London, 1844. Lawes (E.) Proceedings under the Metropolitan Buildings Act, digested and arranged by E. Lawes, Esq. 8vo. London, 1846. Ainger (A.) The Building Act, with Notes and Cases. By A. Ainger, Architect. 8vo. London, 1836. Scriven (J.) The Copyhold and Customary Tenure Act, 4 & 5 Vict. cap. 35, with Analytical Notes and Index. By John Scriven, Esq. 8vo. London, 1841. Gibbons (D.) A Manual of the Law of Fixtures. By D. Gibbons. 8vo. London, 1836. Gibbons (D.) A Treatise on the Law of Dilapidations and Nuisances. By D. Gibbons, Esq. 8vo. London, 1838. Elmes (J.) A Practical Treatise on Architectural Jurisprudence. By James Elmes, M.R.I.A., Architect. 8vo. London, 1827. Reports on the Drapers' Company's Estates, from 1817 to 1839. 8vo. London, 1841. Ditto, 1832. 8vo. London, 1833. Wood (John) The Origin of Building, or the Plagiarism of the Heathens Detected. By John Wood, Architect. Folio. Bath, 1741. Moisy et Duval, Les Fontaines de Paris, Anciennes

et Nouvelles. Par M. Moisy et A. Duval. Folio. Paris, 1812. Denon (V.) Voyage dans la Haute et la Basse Egypt. Par V. Denon. Avec Atlas in Folio. 2 Vol. in 1. 4to. London, 1807. The New Houses of Parliament. Catalogue of the Designs. 2nd Edition. Ditto. 7th Edition. A Letter to Lord Viscount Duncannon. By Thomas Hopper. An Apology for the Designs marked Phil-Archimedes, and Supplement to Ditto. Pamphlets. 4to. London, 1836-37. A Letter from W. R. Hamilton to the Earl of Elgin. Observations on a Letter from W. R. Hamilton, Esq. By Col. J. R. Jackson. Letter to Sir Robert Peel, Bart, M.P., by Lieut.-Col. the Hon. Sir E. Cust, on the Rebuilding the Houses of Parliament. The New Houses of Parliament. On the Proposed Site for the New Houses of Parliament. By Charles Fowler, Architect. Thoughts on the Relative Value of Fresco and Oil Painting, as applied to the Architectural Decorations of the Houses of Parliament. By B. R. Haydon. Pamphlets. 8vo. London, 1836-42.

John Britton, Honorary Member. Brief Notices of the Works and Life of Thomas Cubitt, Esq. By John Britton. 12mo. London, 1856.

The Chester Architectural Society. Journal. Part III. From January to December 1852.

J. P. Cluysenaar, Honorary and Corresponding Member. Chemin de Fer de Dendre et Waes (d'Ath a Lokeren) et de Bruxelles vers Gand par Alost. Bâtiments des Stations et Maisons de Garde. Par J. P. Cluysenaar, Architecte.

Messrs. Davy and Sons. Illustrated Particulars, with Plans, of the Tong Castle Estate, Shropshire. By Messrs. Driver, Surveyors. Folio. London, 1855.

C. Rohault de Fleury, Honorary and Corresponding Member. Rapport présenté au Club de l'Union Polytechnique, dans sa Séance du 20 Mai, 1848, sur la Construction de Logements pour les Ouvriers. Par M. Rohault de Fleury. Pamphlet. 4to. Compte-Rendu des Travaux de la Société libre des Beaux-Arts pendant l'Année Académique, 1843-44. Par C. Rohault de Fleury. Pamphlet. 8vo. Revue Mensuelle des Notabilités contemporaines (Biographie de M.M. Hubert et Ch. Rohault de Fleury). Pamphlet. 8vo. Rohault de Fleury (and others). Rapport sur la Proposition de M. Harou-Romain, relative a l'assainissement des Habitations insalubres. Pamphlet. 8vo. Paris, 1850. Rohault de Fleury fils (Ch). Museum d'Histoire Naturelle, Serres Chaudes, Galerie de Minéralogie, &c. Par Ch. Rohault de Fleury fils, Architecte. Folio. Paris, 1844.

C. Wentworth Dilke. Catalogue of a Collection of Works on, or having reference to the Exhibition of 1851, in the possession of C. Wentworth Dilke. 4to. 1855.

T. L. Donaldson, Fellow, H.S.F.C. Exposition Universelle de 1855. Explication des ouvrages de Peinture, Sculpture, Gravure, Lithographie, et Architecture, &c. 8vo. Paris, 1855. Catalogue des Planches Gravées composant le Fonds de la calcographie, et dont les épreuves se vendent dans cet etablissement au Musée National du Louvre. 4to. Paris, 1851. Report from an Official Committee on Barrack Accommodation for the Army; with Minutes of Evidence, Appendix, and Index. Folio. 1855. The Report of the Commissioners for Enquiring into the Erection of District Lunatic Asylums, Ireland. Small Folio. Report of a Public Meeting of the Nobility, Gentry, and Clergy of the County of Hertford, held at the Town Hall, St. Alban's, on Thursday, April 3, 1856 (reprinted from the "Hertford Mercury."). Pamphlet. 8vo. Hertford, 1856. The Abbey of St. Alban, some Extracts from its Early History, and a Description of its Conventual Church. Pamphlet. 8vo. 1851. Proposed Restoration of St. Alban's Abbey.

W. L. Donaldson, Honorary Solicitor. Rapport au Collége des Bourgmestre et Echevins de la Ville de Liége. Par J. E. Remont, Architect. 8vo. Liége, 1850. The Metropolitan Building Act, 1855. The Office and Duties of a District Surveyor. By Wm. Leverton Donaldson, Honorary Solicitor to the R.I.B.A. Pamphlet. 8vo. London, 1856.

The Editor. Civil Engineer and Architect's Journal, 1854-55.

The Editor. The Builder, 1854-55.

The Editor. Literary Gazette, 1854-55.

The Editor. The Canadian Journal, 1854-55.

The Exeter Diocesan Architectural Society. Transactions. Vol. II. Parts 1 and 2. Vol. V. Parts 1 and 2.

J. Fergusson, Associate. The Illustrated Hand-Book of Architecture; being a Concise and Popular Account of the different Styles of Architecture prevailing in all Ages and Countries. By James Fergusson, M.R.I.B.A. 2 Vols. 8vo. London, 1855.

The Franklin Institute. The Journal of the Franklin Institute, 1854-55.

C. F. L. Förster, Honorary and Corresponding Member. Allgemeine Bauzeitung mit Abbildungen. Von Prof. C.F. L. Förster, Architekt. Plates, Folio. 4to. Vienna, 1854.

Henry Garling, Fellow. The Chronology and History of the World, from the Creation to the Year of Christ, 1753. Illustrated in Fifty-Six Tables. By the Rev. John Blair, LL.D. Folio. London, 1756.

W. P. Griffith, Fellow. Suggestions for a more Perfect and Beautiful Period of Gothic Architecture than any preceding. By W. P. Griffith, F.S.A. Pamphlet. 8vo. London, 1855.

The Guildhall Library Committee. A Descriptive Catalogue of the London Traders, Tavern and Coffee House Tokens current in the 17th Century; Presented to the Corporation Library by H. B. H. Beaufoy, Citizen and Distiller. By Jacob Henry Burn. 2nd Edition. 8vo. London, 1855.

A. Hervieu. Revival of Pictorial Decoration in England. By Auguste Hervieu. Pamphlet. 4to. London, 1856.

R. Hesketh, Fellow. The Metropolitan Building Act, 18th and 19th Vict., cap. 122, with Notes, Index and Engravings. By David Gibbons, Esq., Special Pleader, and R. Hesketh, Esq., Architect and District Surveyor. 8vo. London, 1855. A Synopsis of the Metropolitan Buildings Act, 7th and 8th Vict., cap. 84. By Robert Hesketh. 8vo. London, 1844.

The Institution of Civil Engineers. Proceedings of the Institution of Civil Engineers for the Session 1854-55.

Owen Jones, Fellow. The Grammar of Ornament. By Owen Jones. Parts 1 to 5. Folio.

J. Jopling. A Key to the Proportions of the Parthenon. By Joseph Jopling, Architect. Pamphlet. 8vo. London, 1855. A Key to the Proportions of the Parthenon, Nos. 1 and 2. By Joseph Jopling, Architect. Pamphlet. 8vo. London, 1856.

Adolphe Lance. Du Diplome d'Architecture. Par A. Lance. 8vo. Paris, 1855.

Henry Laxton. Examples of Building Construction, being a Series of Working Drawings to a Large Scale, exemplifying the Arrangements and Details adopted in carrying out the several branches of Trade requisite for Public and Private Edifices. By H. Laxton. Parts 1 to 6. Folio. London, 1855.

F. W. Laxton. The Metropolis Building Act, 18th and 19th Vict., cap. 122, and Notes of Cases explanatory of its Law and Practice. By Frederick W. Laxton, Esq. 8vo. London, 1855.

The Liverpool Architectural and Archæological Society. Proceedings. Vol. II. Part 1.

J. M. Lockyer, Associate. Descripcion del real Monasterio de San Lorenzo del Escorial, su magnifico Templo, Panteon, y Palacio, &c. Por el R. P. M. Fr. Andres Ximenez. 4to. Madrid, 1764.

A. B. Magrini, Honorary and Corresponding Member. Intorno il vero Architetto del Ponte di Rialto, memoria letta il giorno 23 Aprile, 1854, all' I. R. Istituto Veneto di Scienze, lettere ed Arti dal Ab. Antonio Magrini. Pamphlet. 8vo. Vicenza, 1854.

J. Masters and Co. The Ecclesiologist for April, 1856.

D. Mocatta, Fellow. Reflexions et Menus-Propos d'un Peintre Génevois, ou Essai sur le Beau dans les Arts. Par R. Topffer. 2 Vols. 8vo. Paris, 1848.

G. J. Morant, Contributing Visitor. Collection de Projets d'ouvrages d'Architecture, &c. Par C. F. Schinkel. Plates. Folio. Berlin, 1829. Description des Festes données par la Ville de Paris, à l'oecasion du Mariage de Madame Louise-Elizabeth de France, et de Dom Philippe, Infant et Grand Amiral d' Espagne, les vingt-neuviéme et trentiéme Aôut mil sept cent trente-neuf. Plates. Folio. Paris, 1740.

A. H. Morant, Associate. A Glossary of Terms used in Grecian, Roman, Italian and Gothic Architecture. The 5th Edition enlarged. 3 Vols. 8vo. Oxford, 1850.

The Museum of Practical Geology. Catalogue of the Specimens Illustrative of the Composition and Manufacture of British Pottery and Porcelain, from the occupation of Britain by the Romans to the Present Time. By Sir H. de la Beche, C.B., Director, and Trenham Reeks, Curator. 8vo. London, 1855.

C. C. Nelson, Fellow and Honorary Secretary. Egypt and Nubia, from Drawings made on the Spot by David Roberts, R.A., with Historical Descriptions by William Brockedon, F.R.S. 3 Vols. Atlas Folio. London, 1847.

F. W. Oliphant. A Plea for Painted Glass, being an Enquiry into its Nature, Character, and Objects, and its claims as an Art. By Fras. W. Oliphant. 12mo. London, 1855.

John W. Papworth, Fellow. Rapport sur la Proposition de M. Harou-Romain, relative à l'assainissement des Habitations insalubres, par une Commission composée de MM. Bourgeois, Danjoy, Harou-Romain, Adolphe Lance, Lepoittevin et Rohault de Fleury. 8vo. Paris, 1850.

Wyatt Papworth. Department of Science and Art. An Account of the Library of the Division of Art at Marlborough House; with a Catalogue of the principal Works, classified for the use of Visitors to the Library. By Ralph N. Wornum, Librarian. 8vo. London, 1855. Notes on Spontaneous Combustion, an "Appendix to Notes on the Causes of Fires in Buildings." By Wyatt Papworth, Architect. 12mo. London, 1855. Some Account of Hurley Church, Berkshire, extracted from the Gentleman's Magazine for March, 1839. Pamphlet. 8vo.

R. M. Phipson, Associate. Sparrowe's House, Ipswich. (Read before a Meeting of the Suffolk Institute of Archæology and Natural History, at Ipswich, September, 29, 1854). By R. M. Phipson. Pamphlet. 8vo.

The Photographic Society. Journal, 1854-55.

The Royal Geographical Society. The Journal of the Royal Geographical Society. Vol. XXIV. 8vo. London, 1854.

The Royal Institution of Great Britain. Notices of the Meetings, November, 1853, to July, 1854; Part IV. List of Members. Notices of the Meetings; Part V. November, 1854, to July, 1855. A List of the Members, Officers, &c., with the Report of the Visitors for the Year 1854.

The Royal Society. Proceedings of the Royal Society. Vol. VII. Nos. 4 to 12.

The Royal Society of Edinburgh. Transactions. Vol. XXI. Parts 1 and 2. Proceedings, 1853-54.

Sydney Smirke, Fellow. A Letter to Sir C. L. Eastlake, P.R.A., suggesting a mode of assisting the Eye in the right perception of Colour in Pictures. By Sydney Smirke, A R.A.

Societé libre des Beaux Arts. Revue des Beaux Arts, 1854-55. Notice Biographique sur Louis Alexandre Péron. Par M. Moultat. 8vo. Paris, 1855.

The Society of Arts. The Journal of the Society of Arts, 1854-55.

H. R. Twining, Contributing Visitor. The Elements of Picturesque Scenery, or Studies of Nature made in Travel, with a View to Improvement in Landscape Painting. By H. R. Twining. Vol. II. 4to. London, 1856.

M. D. Wyatt, Fellow. Paris Universal Exhibition. Report on Furniture and Decorations. By M. Digby Wyatt. Pamphlet. 8vo. London, 1856.

James Yates, M.A. A Narrative of the Origin and Formation of the International Association for obtaining a uniform Decimal System of Measures, Weights and Coins. By James Yates, M.A. Pamphlet. 8vo. London, 1856.

L. de Zanth, Honorary and Corresponding Member. La Wilhelma, Villa Mauresque de S. M. le Roi Guillaume de Wurtemberg, executée d'après les plans et sous la direction de L. de Zanth, Architecte du Roi, &c. 1, 2 et 3 livraisons. Folio. Paris, 1855.

BOOKS PURCHASED.

Viollet Le Duc. Dictionnaire raisonné de l'Architecture Française du XI^e^ au XVI^e^, siècle par M. Viollet Le Duc, Architecte du Gouvernement, &c. Tome premier. 8vo. Paris, 1854.

Guilhermy, M. de, et Viollet Le Duc. Description de Notre-Dame Cathedrale de Paris, par M. de Guilhermy et M. Viollet Le Duc. 8vo. Paris, 1856.

PROCEEDINGS AT THE ORDINARY & SPECIAL GENERAL MEETINGS, PAPERS READ, &c.

From the 7th of May, 1855, *to the 28th of April*, 1856.

14*th May*, 1855.—*Special General Meeting.* A Committee was appointed to consider the Subject of Premises for the Institute, and another Committee was appointed to consider the Metropolitan Building Bill, 1855, and to take such steps relative thereto as might appear requisite.

21*st May.*—"A Summary of a Report made by Mons. Remont, Architect of the City of Liège, on the Sanitary Measures adopted in London," by W. L. Donaldson, Hon. Solicitor.

Models of Round's Patent Bricks were exhibited.

4*th June.*—"A few Remarks on Italian Architecture," by the Rev. J. L. Petit, Hon. Member.

Specimens of highly polished Serpentine Marble from the lower beds of the deep quarries of the Lizard in Cornwall, were shown by the Lizard Serpentine Company.

11*th June.*—*Intermediate Meeting.* "An Enquiry as to the Methods which it is most advisable to adopt in the Metropolitan Building Bill for regulating the Thickness of Walls," by Robert Hesketh, Fellow.

A Resolution was passed that it was not desirable to change the principle of Rating Buildings existing in the present Act, and the Thickness of Walls consequent thereon, and that it was desirable to retain the Schedules relating to these subjects in the same Act, except as to the Public Building Class.

18*th June.*—"Practical Observations on Pile Driving," by G. R. Burnell, C.E.

Specimens of Ornamented Consolidated Glass, of Mellish's Perforated Glass Ventilators, of Grant's Lamp Inscriptions, of Hoare's Sliding Rule, and of Abate's Nature Printing from Wood, were exhibited.

Mr. Brown explained his system of Ventilation.

5*th November.*—"Considerations upon some of the Objects connected with Architecture in the Exposition des Produits de l'Industrie at Paris, 1855," by J. W. Papworth, Fellow.

The Chairman, Mr. Tite, V.P., M.P., offered some remarks on the Present Condition and Future Prospects of Architecture in England.

19*th November.*—"An Abridgment of M. Lance's Essay on a Diploma in Architecture, with Remarks and Suggestions," by J. W. Papworth, Fellow.

3*rd December.*—A discussion on a Diploma in Architecture took place.

The Hon. Secretary for Foreign Correspondence announced the decease of Messrs. Sprenger, Nobile and Weenink, Hon. and Corr. Members.

The unique Chimney Pot, invented by Mr. Moon, was exhibited.

An oil painting, said to be a Portrait of Sir Christopher Wren, was shown by Mr. Foggo.

17*th December.*—*Special General Meeting.* The following gentlemen were appointed, under Sec. 33 Metropolitan Building Act, 1855, Examiners for the year 1856 of Applicants for Certificates of Competency to perform the Duties of District Surveyor:—

The Vice-Presidents and the Hon. Secretaries for the time being, with Messrs. Fowler, Godwin, Hesketh, Inman, Pennethorne, Pownall, and Smirke, S., Fellows.

17*th December.*—"On some French Chateaux of the age of Francis I," by E. I'Anson, Fellow.

Some Specimens of Gibbon's Carving, to which measures had been applied to prevent further decay, were shown by Mr. W. G. Rogers.

The decease of A. J. Green, elected Fellow from the Class of Associates, Dec. 3, 1855, was announced.

14*th January*, 1856.—"Remarks on the Forms, Methods of Casting, and Ringing Large Bells, with some suggestions on the subject," by C. H. Smith, Hon. Member.

The decease of W. Mountford Nurse, Hon. Fellow, was announced.

The Hon. Sec. Foreign Correspondence pronounced an eulogium on the late Thomas Cubitt.

28*th January.*—The discussion on Bells was continued by Mr. E. B. Denison, Visitor.

The decease of G. T. Andrews, Fellow, was announced.

11*th February.*—The discussion on Bells was resumed and brought to a close.

The Chairman, Mr. Tite, V.P., explained some of his remarks made at the opening Meeting of the Session.

18*th February.*—*Special General Meeting.* In conformity with the recommendation of the Council, it was unanimously resolved to submit to Her Majesty's gracious consideration that the Royal Medal for the year 1855 should be awarded to Mr. Tite, Fellow, F.R.S., M.P.

The Report of the Council on the Essays and Drawings sent in competition were read and confirmed, and

The Silver Medal of the Institute was adjudged to Mr. T. A. Britton for his Essay on the Timber Growing Countries of Europe and America. The Soane Medallion to Mr. L. R. Roberts for his Design for a Town Mansion. A Medal of Merit to Mr. T. C. Sorby, for his Design for Courts of Law; a Medal of Merit to Mr. J. Blake, for his Design for a Town Mansion; and a Prize in Books to Mr. C. N. Beazley, Student, for his Monthly Sketches.

The recommendations of the Council with reference to the Medals for the year 1856, were read and agreed to.

25*th February.*—"Archæological Studies in Jerusalem," by G. J. Wigley, Associate.

A Letter was read, dated February 21, 1856, addressed to the Earl de Grey, K.G., President, from General Grey, conveying by command the information to his Lordship, that Her Majesty had been pleased to approve of the proposed appropriation of the Royal Gold Medal to Mr. Tite.

A communication to the Hon. Secretaries from G. G. Scott, Fellow, dated December 3, 1855, was read, being a reply to the remarks made at the Ordinary General Meeting, held November 19, 1855.

A resolution of the Council of February 4, 1856, with respect to granting a Diploma in Architecture, was read.

Speceimns of Beadon's Eaves Gutter Tiles were exhibited.

10*th March*.—"Archæological Studies in Jerusalem," by G. J. Wigley, Associate.

A Letter was read from Mr. Tite, conveying his grateful acknowledgment for the recommendation of the General Meeting that his name should be submitted to Her Majesty for the award of the Royal Medal.

Wood Carvings from Belton House were exhibited by Mr. Rogers; and Specimens of Internal Pictorial Decoration, by Mons. Hervieu.

31*st March*.—"On the Triumphal Arches of the Romans, with Illustrations," by T. L. Donaldson, Hon. Sec. Foreign Correspondence.

The decease of J. Neeld, M.P., Hon. Fellow, was announced in a letter from James Thomson, Fellow, to the Honorary Secretaries.

The Earl de Grey, President, presented the Royal Gold Medal, and the other Medals and Prizes to the gentlemen to whom they had been awarded at the Meeting of the 18th February.

A Model of the extensive Range of Buildings erected in Victoria Street, Westminster, was exhibited by Mr. Dighton.

14*th April*.—"On Open Fire Places, with Remarks on their Construction," by S. E. Rosser, C.E.

28*th April*.—"On the Preservation of Wood Carvings," by Henry Crace.

"Description of R. M'Connel's Composite Iron Beam."

Drawings and diagrams were exhibited at the various Meetings to illustrate and explain the different subjects treated in the papers read.

MEDALS AND PRIZES AWARDED.

ROYAL GOLD MEDAL.

1848. C. R. COCKERELL, R.A.
1849. CAV. L. CANINA, Hon. & Cor. Member.
1850. C. BARRY, Fellow, R.A.
1851. T. L. DONALDSON, Fellow.
1852. CHEV. LEO. von KLENZE, Hon. & Cor. Member.
1853. SIR R. SMIRKE, Hon. Fellow, R.A.
1854. PHILIP HARDWICK, Fellow, R.A.
1855. J. J. HITTORFF, Hon. & Cor. Member.
1856. WILLIAM TITE, Fellow, M.P.

INSTITUTE MEDAL.

1836. Geo. Godwin, Associate.

1838. W. W. Pocock, Associate.

1840. Herr Hallmann.
1841. E. Hall.
1842. Anonymous, with motto—
(Alas! what perils do environ.)
1843. E. Chamberlain.

1845. S. J. Nicholl, Student.
1846. Chevalier Beuth.
1846. T. Worthington.
1847. J. W. Papworth, Fellow.
1848. H. B. Garling, Associate.
1849. Wyatt Papworth.
1853. J. H. Chamberlain.
1853. C. T. Hargrave.
1854. E. L. Tarbuck.
1855. W. P. Griffith, Fellow.
1855. W. Salzenberg.
1856. T. A. Britton.

SOANE MEDALLION.

—

1838. S. Sharp, Associate—
1839. S. Sharp, Associate.
(The Medallion with a gold rim.)

1842. J. W. Papworth, Associate.
1843. A. Johnson, Student.

1848. J. Maclaren.

1856. L. R. Roberts.

MEDAL OF MERIT.

—

1838. G. E. Laing, Architect.
1839. W. W. Pocock, Associate.
1839. E. Hall.

1843. J. W. Papworth, Associate.

1846. S. J. Nicholl, Student.
1846. J. F. Wadmore.
1847. J. Bell, Associate.

1852. J. T. Knowles, Jun.
1853. W. G. Coldwell, Associate.
1853. J. T. Knowles, Jun.
1854. T. A. Britton, Student.
1854. J. G. Elgood.
1854. C. F. Hayward.
(With an honourable addition.)

1856. T. C. Sorby.
1856. J. Blake.

PRIZE BOOKS.

1839. W. Clerihew, Associate.
1843. A. Johnson, Student.
1844. A. J. Baker, ditto.
1844. W. W. Deane, ditto.
1845. G. Judge, Jun. ditto.
1845. W. W. Deane, ditto.
1846. G. Judge, Jun., ditto.
1846. S. J. Nicholl, ditto.
1847. W. Boutcher, ditto.
1847. S. J. Nicholl, ditto.
1848. Bright Smith, ditto.
1848. T. Hill, ditto.
1849. T. Hill, ditto.
1850. Bright Smith, ditto.
1852. B. Fletcher, ditto.
1852. W. Lightly, ditto.
1852. W. Lightly, ditto.
1852. T. C. Tarring, ditto.
1853. T. A. Britton, ditto.
1854. F. T. Gompertz,
1855. C. N. Beazley, ditto.

SUBJECTS FOR MEDALS, 1856.

At the Special General Meeting, held on Monday, 18th February, 1856,

The following Recommendation of the Council with reference to the ROYAL MEDAL for the year 1856, was read and agreed to:—

Her Majesty having been pleased to grant her gracious permission that the Royal Medal be conferred on such distinguished Architect or Man of Science, of any Country, as may have designed or executed any building of high merit, or produced a work tending to promote or facilitate the knowledge of Architecture, or the various branches of Science connected therewith.

That the Council do proceed in January, 1857, to take into consideration the appropriation of the Royal Medal.

The following Recommendations of the Council were also read and agreed to:—

INSTITUTE MEDAL.

That the Silver Medals of the Institute be awarded to the Authors of the best Essays on any subjects tending to promote or facilitate the knowledge of Architecture, or the various branches of Science connected therewith.

The Essays to be written *very legibly* on alternate pages, and to be accompanied by suitable illustrations.

That the Silver Medals of the Institute be also awarded for the best illustrations from actual measurement, with descriptive particulars, of a mediæval building, hitherto unpublished, in Ireland.

For the like subject in Scotland.

The drawings to consist of at least one plan, an elevation, and a section, drawn to the scale of $\frac{1}{8}$ of an inch to the foot, with details to a larger scale.

SOANE MEDALLION.

That the Soane Medallion be awarded for the best design, in not less than five drawings, for—

A large Metropolitan Hotel, calculated for the reception of foreign princes and their suites, of the families of the nobility, and of private individuals; accommodated by distinct entrances and staircases, communication being still preserved with the other parts, so that they may be separated or thrown into one establishment. The whole to form a detached block of building, measuring 300 ft. by 200 ft. The stable offices need not be considered or included in the design.

The plans, elevations and sections of the building to be drawn to the scale of $\frac{1}{8}$ of an inch to a foot. Perspective views, and such other drawings to a larger scale as the Candidate may consider necessary for the perfect development of his design. The drawings to be tinted *only* with Indian ink or sepia.

The successful Competitor, if he go abroad within three years after receiving the medallion, will be entitled to the sum of £50. at the end of one year's absence, on sending satisfactory evidence of his progress and his studies.

The competition for the Soane Medallion is open to all Members of the Profession under the age of thirty years.

DIRECTIONS FOR COMPETITORS.

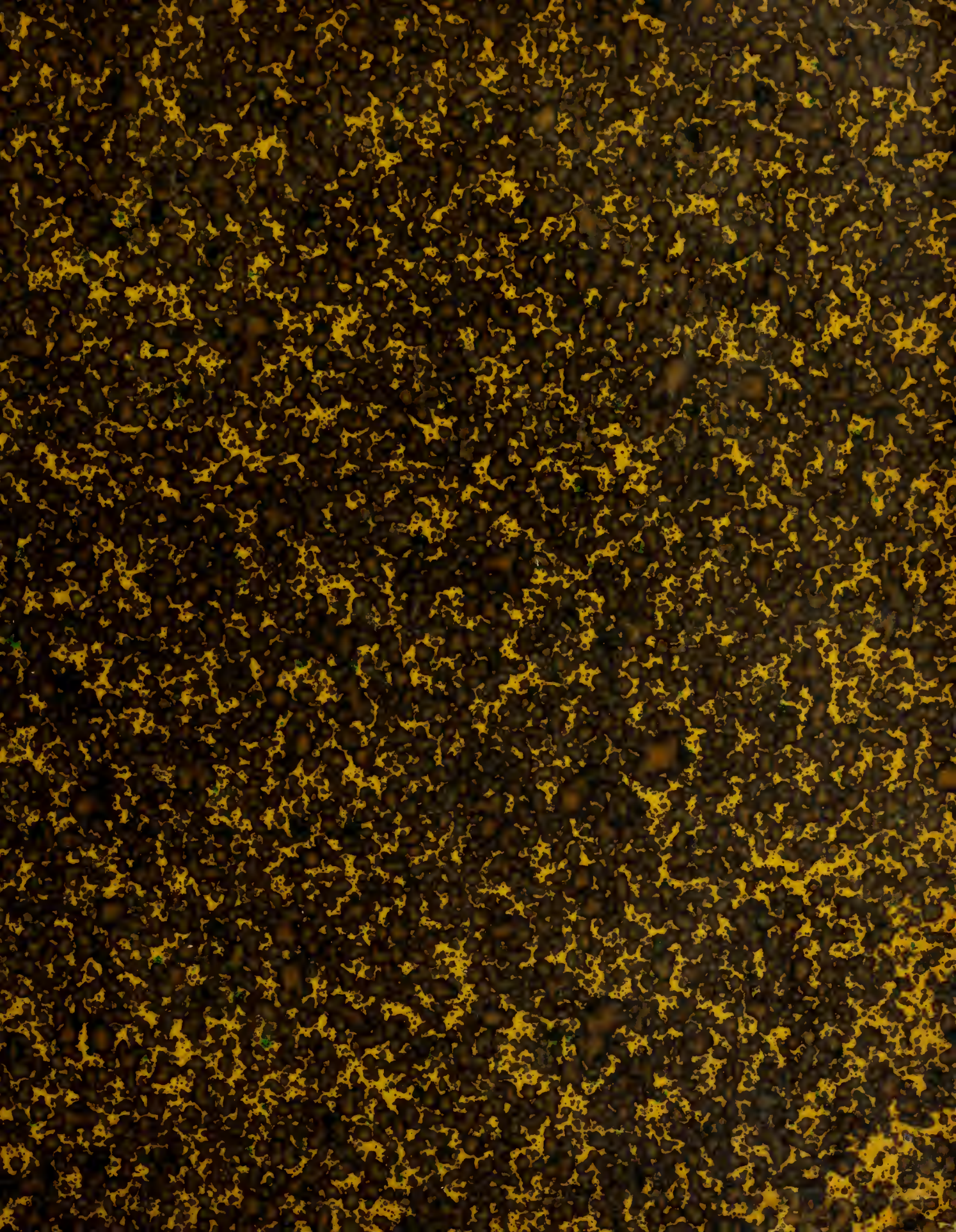
Each Essay and set of Drawings is to be distinguished *only* by a mark or motto, *without the name of the author attached*, but it is to be accompanied by a Letter, sealed with a *blank seal*, and having on the outside the same mark or motto as that attached to the Essay or Drawings, and enclosing his name, with an address to which a communication may be sent, The packet directed, *To the Honorary Secretaries of the Royal Institute of British Architects*, and marked *Essay for Medal* (or) *Drawings for Medal (Motto)* is to be delivered at the Rooms of the Institute on or before the 31st of December, 1856.

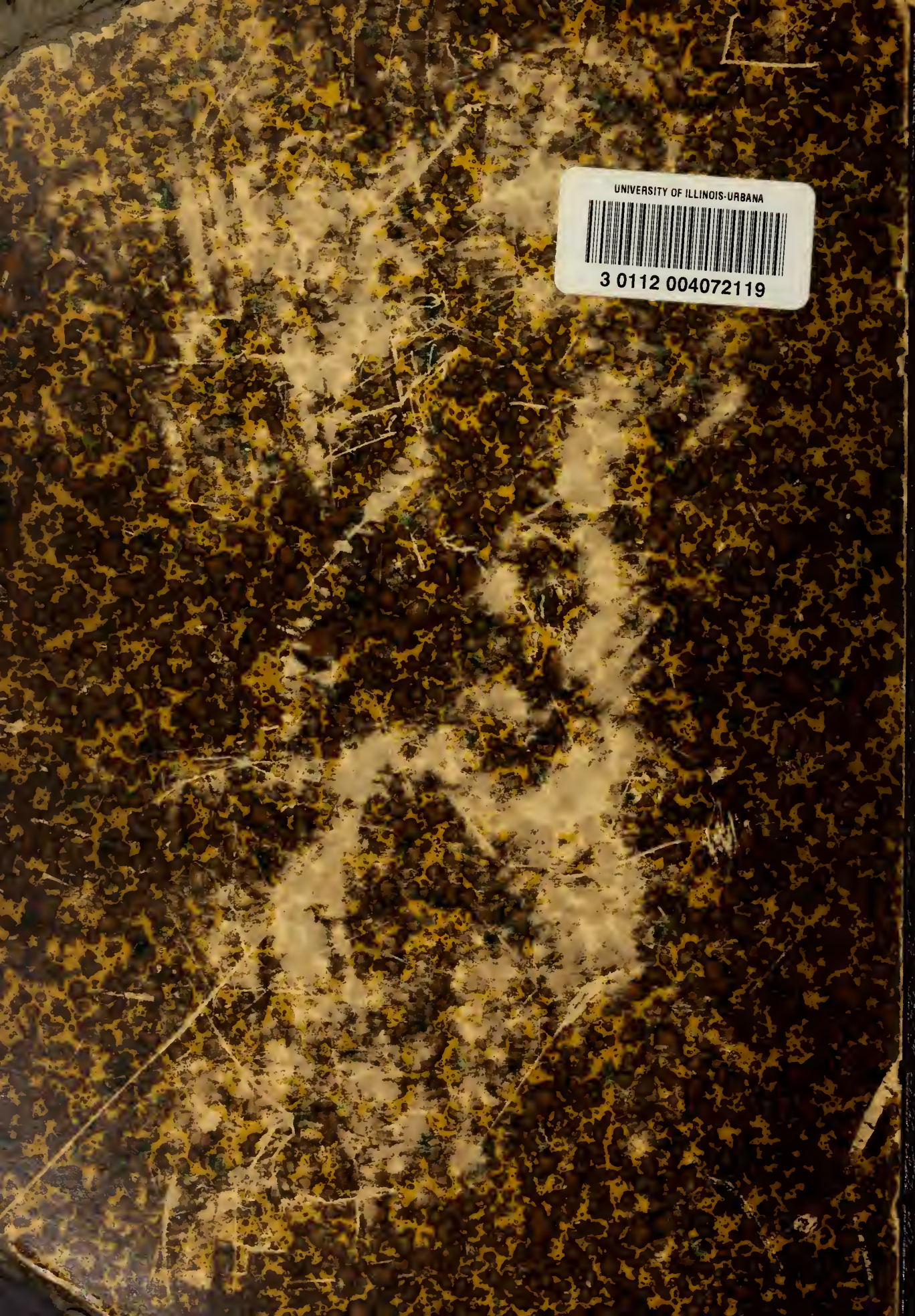
The Institute will not consider themselves called upon to adjudge a Premium, unless the Essays and Drawings, and the subjects and buildings respectively shall be of sufficient merit and importance to deserve that distinction ; and if the best Essay or Drawings should be by a Candidate who has been successful on a former occasion, they reserve to themselves the power of adjudging such other adequate reward as they may think fit, and of awarding the Medals offered to the second in merit. The Essays to which Premiums are awarded, become the property of the Institute, to be published by them if thought fit. In case the Essays are not published within six months after the award of the Medals, the authors will be at liberty to publish them. The Drawings will be returned to all the Candidates, on application; to the unsuccessful ones, after the adjudication, and to the successful ones after the presentation of the Medal.

Attention is required to strict compliance with the above Directions.

Copies of this Paper, or any further information, may be had on application to the Honorary Secretaries, by letter, pre-paid.

J. Davy and Sons, Printers, 137, Long Acre.

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